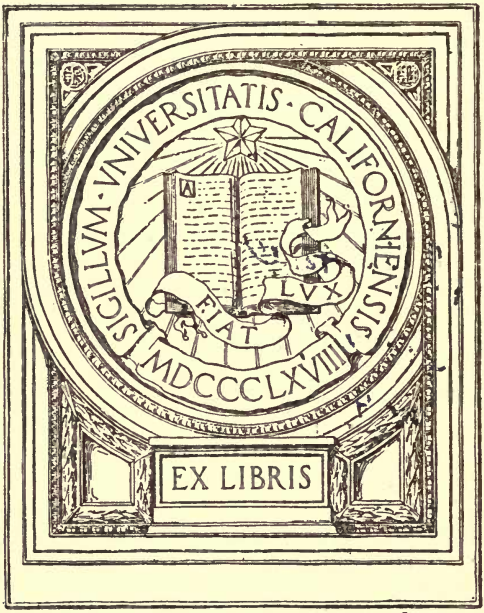
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THE FILM INDUSTRY

PITMAN'S COMMON COMMODITIES AND INDUSTRIES

THE FILM INDUSTRY

BY

DAVIDSON BOUGHEY

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PREFACE

THIS book is neither a critical analysis nor a complete technical treatise, but just a brief and, it is hoped, clearly written survey of the youngest of the world's great industries—one which provides both education and amusement for many millions of people every week in the year, and one which is, to the average man and woman, veiled in mystery and romance.

The success of this series has proved conclusively that there are many people who desire knowledge of the kind given without wishing for a lengthy scientific treatise of a professional character, and it is to this growing section of the public that it is hoped this book will especially appeal.

To Mr. Charles Domville-Fife, the well-known author, I wish to express my obligations for the great literary help so readily given me throughout the work. My thanks are also due to Mr. Colin M. Williamson, of London, the recognized scientific expert on things cinematographic ; Mr. Ellison Kayle, of San Francisco, California, an authority on the artistic side of the industry ; and to Messrs. W. Butcher and Sons, Ltd.; the Williamson Kinematograph Co., Ltd. ; Famous Players-Lasky British Producers, Ltd. ; the British Thomson-Houston Co., Ltd. ; Mr. George Palmer ; the Watkins' Meter Co., of Hereford ; and many others for the assistance they have so kindly rendered, and for the loan of illustrations.

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INTRODUCTION

THE YOUTH AND GROWTH OF THE FILM INDUSTRY

THE meteoric rise of the cinematograph industry from scientific experiment to world-wide industrial and commercial importance is of such recent occurrence that it will be more or less familiar even to the younger generation. To attempt to record here each historic step forward, every improvement in the apparatus employed, the artistic elevation of the films themselves, and the evolution of the electric theatre from a showman's tent to a palace of educational amusement equal, and in many cases superior, to the finest theatre or opera-house, would occupy more pages of print than can legitimately be spared here for the description of the whole of this gigantic industry at the present time. Moreover, a great deal of doubt exists in regard to many of the earlier incidents. So rapid was the rate of development in so many lands, and so extraordinary the present process of evolution that only a mass of conflicting dates and patent specifications confront the would-be historian of this youngest competitor in the World of Art, Literature, Science and Industry.

Between the years 1890-3, Edison produced his famous Kinetoscope in the United States, and a year later Mr. Robert W. Paul began making similar instruments in Great Britain. Both of these pioneers were compelled to produce their own films, which were then only 40 ft. in length.

In America one invention followed another with astonishing rapidity, and in England a Mr. Blair produced the first celluloid film coated with emulsion in 1895. In the same year Mr. Paul joined forces with another investigator in the cinematograph field, Mr. Birt Acres,

and the first producing studio in England was opened at Barnet. The Derby was one of the first subjects to be filmed, with the aid of a camera constructed by Mr. Paul, and several copies of this film were sold for projection in the Kinetoscope ; one being shown with great success at Earls' Court Exhibition.

In the following year Mr. Paul designed his first projector, which he called a "Theatrograph," and about the same time Messrs. Lumiére et Fils, of Paris, produced the Kinematograph. In America, Mr. Thomas A. Edison was rapidly perfecting various machines, and a new industry was being born. The Theatrograph was succeeded by the Animatograph in 1896, which was demonstrated at the Alhambra Theatre, London ; and simultaneously with this new projector Mr. Paul designed the cine-camera with which films of the festivities of Queen Victoria's Jubilee were taken in 1897.

The Empire, London, was actually the first theatre in England to show moving pictures, and the Lumiére Kinematograph was the projector used, but the Alhambra, with Mr. Paul's Animatograph, was a good second, and Olympia, with the same instrument, came third. It is interesting to note that a Mr. Cecil Hepworth supplied the hand-fed arc-lamps for use in Mr. Paul's earliest apparatus ; and that a hand-coloured film of about 40 ft. was shown about this time.

The animatograph was steadily improved until, in 1902, other theatres showed a desire to include motion pictures in their programme. Among these must be mentioned the Canterbury Music Hall and the Britannia Theatre. From this date onward to the present day the development of cameras, projectors, films and cinematograph machinery generally has been extraordinarily rapid, especially in the United States and in France. Messrs. Pathé Frères figure among the list

of purchasers of the first Derby film taken by Mr. Paul, and from that date onwards this famous firm has been in the forefront of the industry in this country and elsewhere. In America, the Edison Company, The American Biograph, and other even earlier concerns had succeeded in advancing the whole industry from the experimental to the commercial stage, thereby giving to our cousins across the Atlantic a wonderful lead which they are still able to maintain, although in both England and France many powerful firms are yearly securing a larger share in the general prosperity of the film industry.

The course of central and local legislation affords some idea of the rise to popularity of cinematograph theatres in Great Britain, and is also indicative of the extreme youth of the whole industry so far as that country is concerned. It was not until long after success had been assured to the exhibition side that the actual production of films was commenced. Had the two sides of this industry advanced in unison, the importation of foreign films would never have reached the present gigantic totals. The long delay in recognizing the great future of film production—a future pregnant with psychological and political importance as well as artistic and commercial—was in part responsible for the lead obtained by foreign nations, and the place which American films in particular have won in the hearts of appreciative British audiences. It should be remembered in this connection that the psychology of the American film is so much more in keeping with English ideas and customs than that of French and Italian productions that, although the competition offered by the latter can be more or less disregarded by British producers, the former cannot be treated lightly. With its Anglo-Saxon psychology and setting, combined

with wide range and novelty of scenery, to say nothing of the excellence of the acting and production, it has won a strong and legitimate hold. To meet this competition on fair ground, the aid of Colonial scenery, stirring incidents in quite modern history, and healthy British psychology must be called to the aid of the vast literary stores and manufacturing powers of the United Kingdom.

American producers do not take all their stories from life in the East side of New York City nor in the abattoir of Chicago ; they go far afield into the desert tracts of Arizona and California, the Rocky Mountains, the pine forests of Oregon, the woods and lakes of Maine, snowy Alaska, and palm-fringed Florida. They do not attempt to ingraft a liking for the psychology of long past ages, which have ceased to be either intelligible or inspiring to the average man, woman or child.

But this is a digression. To return to the subject of this introductory chapter, the first cinematograph act relating to the licensing of film exhibitions in Great Britain was passed as recently as 1909. This was followed by various regulations as to safety made by the Home Secretary and by the Secretaries for Scotland and Ireland, in 1910–13. A veritable host of local ordinances were passed between these dates and the year 1915, including the Celluloid Acts. The original Cinematograph Act was repealed and a new Statute passed in 1910, which was amended in 1913. In 1914–15 came the clauses affecting the export of films in the Defence of the Realm Regulations. The Entertainment Taxes of 1916–17, and the privately arranged film censorship in 1913.

From these few facts relating to the position of cinematography in the eyes of the law, some idea will be obtained of the quite modern development of this

industry ; which, in 1908, employed under 1,500 people in the British Isles, and in 1919 over 200,000. The number of electric theatres in operation at the present time exceeds 4,000, and it is estimated that at least another 2,000 are required to comfortably accommodate the 7,000,000 to 9,000,000 weekly patrons. The capital invested in the whole industry reaches the colossal figure of £168,000,000 sterling.

It is interesting to note that whereas in 1908–10 the cost of erecting a building which was then considered suitable for an electric theatre seldom exceeded £1,500 to £2,000, the cost of a modern picture palace varies from £80,000 to £300,000. A five-reel picture in the earlier years was produced for as little as £4,000 to £5,000, whereas to-day anything from £15,000 to £50,000 is required for a really good production.

The average annual importation of films into the United Kingdom is approximately 160,000,000 ft. ; of which between 60 and 70 per cent comes from the United States. One large American firm has for several years shown a profit of nearly 3,000,000 dollars per annum.

Statistics of the cinematograph industry, so far as many foreign countries are concerned, are difficult to obtain. The number of cinemas in the United States has been given as 16,900 (exclusive of travelling shows), and the premier theatre is the " Capitol," in New York City, which has a seating capacity of over 5,000. Reliable estimates place the number of cinemas in the world at 87,000 and the film requirements at about 1,500,000,000 ft. per week, of which at least 50,000,000 ft. must be entirely new subject matter.

This brings us to the four-fold nature of film production. First comes the manufacturing of the celluloid film, and the coating of this transparent base with photographic emulsion; then there is the optical and engineering

work in the making of cinematograph cameras, projectors, perforators, dynamo-lighting sets, printers, mercury-vapour lamps, and other machinery and optical instruments used in the various branches of the industry ; next comes the combined literary, artistic, dramatic, and photographic operations known by the generic name of film-production, with the necessary studios, scenery, lighting and technical staffs ; and finally, there is what may be termed the retail side of this great industry, the distribution, and the exhibition of the films in the electric theatres.

In order to further complicate any attempt at adequate description, each of these natural divisions of the industry has several distinct branches. The making of the film material is divided between (1) the production of the thin sheet celluloid, and (2) the cutting of this into suitable lengths for coating with photographic emulsion, the cutting of the standard size ribbon, and the perforation of the edges for use in subsequent processes. The engineering side of the industry has many branches which it is unnecessary to enumerate here, as this will be treated in extenso in later pages, and the same applies to film production and exhibition, only, between these two latter there is the wholesale middle-man, or film renter, which is an important business distinct from either the production or the exhibition. The studio work is so complicated and relies for success upon such close co-operation between author, actor, artist, director, and photographer, to say nothing of the financial side, that several long chapters must be devoted entirely to it.

The first of these divisions, the manufacture of the celluloid film, which does not form a legitimate part of the film industry as it is generally understood, will only be treated briefly, in order to have sufficient space for a full description of modern film production and exhibition.

THE FILM INDUSTRY

CHAPTER I

THE CINEMATOGRAPH FILM

In the description of a great industry perhaps the most difficult thing is to decide at what point to begin. From the raw material to the finished product is the best plan of action for a general treatise such as this, but, when the raw material used in the industry under review is, itself, but a manufactured article, no natural basis or finality could be obtained that way.

These considerations would seem to make it advisable to take the "made film" as the true point of departure for a tour of inspection through the youngest of all the great industries of the world. Here comes the first difficulty occasioned by the choice of a starting point. What is "made film"? To the average individual it is the celluloid ribbon upon which there is a complete series of pictures ready for showing, with the aid of a projector, on the screen of a cinema hall. This, however, is really the finished product!

There are two distinct types of cinematograph film, known as "positive" and "negative." The latter is first used to record the pictures with the aid of a special camera, and the former is the completed article which is passed through the projector in the cinema halls. Both are transparent and have a celluloid base. The raw material of the industry is therefore the emulsioned and highly-sensitive *negative* film in its unexposed

condition, and the finished product is the developed *positive* film with the series of pictures on its surface. Between the receipt of the one and the release to the trade of the other lie all the complicated processes of film-production.

The base or transparent foundation of both positive and negative film is celluloid, a highly inflammable substance made from camphor and tetra-nitro-cellulose, mixed and compressed. The positive film is, however, specially toughened to enable it to stand being passed through many projectors during its travels round the electric theatres.

Before being coated with sensitive photographic emulsion both the positive and negative bases are known as *raw-film stock*, which consists of long rolls of very thin celluloid, about a yard wide. In order to make the negative, a roll of this is coated on one side with silver-bromide emulsion, and to make the positive a roll of the specially toughened celluloid is coated on one side with a much less sensitive, or slower photographic emulsion. The negative is orthochromatic, or sensitive to green, yellow, blue and violet light, but the positive is not orthochromatic, and can therefore be handled in yellow or orange light.

After coating with the more or the less sensitive emulsion, as the case may be, the long rolls of celluloid are cut into strips or ribbon $1\frac{3}{8}$ ins. wide and 400 ft. long. The average thickness is about six-thousandths of an inch. The long strips are then perforated, rolled on bobbins, enclosed in light-tight cases and sent to the film-producing studios or factories. The negative to be used in the cinematograph camera for taking the pictures and the positive for obtaining "prints" from the negative and for use in the projecto s of the exhibiting theatres.

It is at this point that the film industry really takes up the work. The making of the emulsion-coated celluloid is entirely within the province of the manufacturer of photographic materials, such as the Eastman Kodak Company of Rochester, U.S.A., and the Birmingham Photographic Company (Criterion), of Stetchford, Birmingham, England.

The rolls of both negative and positive film, as supplied by the makers, vary in length from 200 ft. to 400 ft., but they can be easily cut with a pair of scissors or joined with film cement. In this way any required length can be made up.

Before being used both kinds of film must be passed through a machine which cuts small oblong holes, at regular distances from each other, along both edges of the celluloid. These perforations enable the teeth of sprockett wheels to engage and move the film along, which is the universal way of passing negative and positive through camera, printer and projector. More will be said upon this subject, however, in a later chapter.

In addition to the ordinary and almost explosively inflammable celluloid film-base there is a special kind called "Non-flam," which is as nearly fire-proof as appears to be possible. This base is sometimes employed for making the positive films which are sent round to the cinema theatres. It would be even more used if the transparency and toughness could be still further improved.

The positive film, being the base used for the finished product of the industry, can now be left for future reference. It has much in common with the print taken from an ordinary photographic negative, and is not employed until the original, which in this case is a series of pictures, has actually been made.

The first of the two kinds of film to be considered is,

therefore, the negative, which is supplied to the industry in rolls ready to be taken to the dark-room and there unpacked from its light-proof wrapping and placed in the film-boxes ready for the cameras. A certain amount of care is necessary when doing this because it frequently happens that the end of the roll of film is stuck down, and if pulled apart suddenly will cause an almost imperceptible discharge of static electricity. Should this occur the highly sensitive emulsion will become marked and the whole roll rendered useless. The stuck-down end of the film must be very gently pulled free.

Every cinematograph camera is fitted with two film-boxes ; the one to hold the roll of new, or unexposed negative, and the other to take-up this film after exposure. In some cameras these boxes are fitted on the outside of the case, but in the principal British makes they are contained within the camera. They can, of course, be removed in the daylight, but must be filled and emptied in the dark-room.

The box itself is a very simple affair, as will be seen from Fig. 1, and may hold anything from 100 to 330 ft. of film. There are, however, some very large studio cameras which have boxes capable of containing up to 1,000 ft. of film, but they are far too heavy and cumbersome for general out-door use.

The film-box consists of a thin metal or wood outer case with a hinged door, which is opened in the dark-room and the roll of negative film placed over the central bobbin. The loose end of the film is then passed under the roller and out through the velvet-lined slot in the bottom corner of the box, and is left hanging. The door is then firmly closed, and the box may be taken out of the dark-room and either fitted immediately into the camera or carried as a spare.

The arrangement, when inside the camera, of the

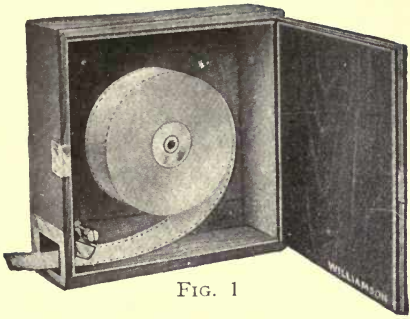


FIG. 1

FILM BOX

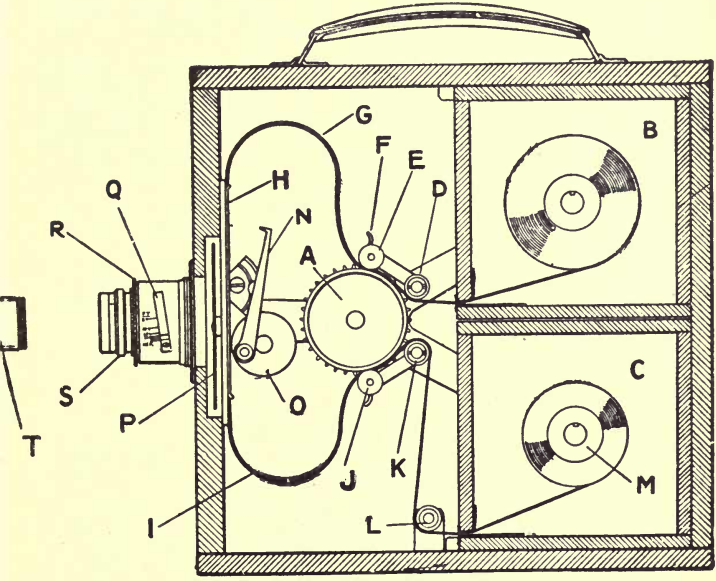


FIG. 2

WILLIAMSON TOPICAL CINEMATOGRAPH CAMERA

loaded film-box, holding the roll of unexposed negative, and the take-up box for receiving the film after exposure, can be seen in Fig. 2, which shows the interior of a Williamson topical cinematograph camera.

In order to *thread-up* ready for operating the loose end of the film left hanging outside the velvet-lined slot of the supply-box is passed under the fixed roller, beneath the spring-finger, which presses the film so that the teeth of the sprockett wheel engage in the perforations in both sides of the film, and is then slipped sideways under the gate, which holds it close to the lens aperture. Finally, it is carried under the sprockett wheel, over the two rollers, and into the velvet-lined slot of the lower, or take-up film-box.

When this has been done all that remains is to fix the film end to the bobbin in the centre of the take-up box, give the camera handle a half-turn to ensure that the take-up is winding properly, and that the film is travelling evenly past the gate.

The door of the supply-box has, of course, been kept closed since leaving the dark-room, otherwise not merely the short lead of film left hanging outside the slot but the whole roll on the bobbin would have become fogged by the daylight. The take-up box door can now also be carefully closed, together with that of the camera, and everything is ready to make an exposure.

Before describing the actual taking, or *filming* as it is called, of motion pictures, several succeeding chapters must be devoted to the cinematograph camera and other essential mechanical appliances of the industry. For, without a working knowledge of these, many of the processes and difficulties to be described would be quite unintelligible to the lay reader.

CHAPTER II

THE CINEMATOGRAPH CAMERA

CONTRARY to the general belief, there is nothing very complicated in the general design or mechanical details of the up-to-date cine-camera, which is little more than an ordinary roll-film camera arranged so that, by the turning of a handle on the outside of the case, a number of pictures, amounting to about sixteen a second, may be taken in succession instead of from one to six, as in the ordinary snap-shot apparatus.

In order to convey the appearance of motion when thrown on the screen it is necessary that the pictures should be taken from the same point of view in rapid succession, at the rate of about sixteen a second, and that each individual picture should have an exposure of from one-thirtieth to one-hundredth of a second. Thus, if it were possible to take the photographs and effect the necessary changes of film *by hand* in such quick time something approaching a cinematograph film could be obtained with the ordinary film-camera, but as this is quite impracticable, mechanical devices are employed to carry out the necessary movements within the camera case.

This comparative simplicity ends, however, with the camera itself. Almost any intelligent boy or girl is able to focus and "snap" with an ordinary camera, but the practical and artistic operation of a cine-camera calls for considerable skill and artistic conception combined with experience. To realize this an amateur has only to consider what *average* result he would obtain if on every occasion he took several hundred pictures

in a few seconds instead of one or possibly two, and of rapidly moving objects, perhaps in rain, or under the glare of sunlight on snow, sea or wet sand, after travelling many miles for the sole purpose of obtaining a picture. A spoilt cine-film is a costly failure.

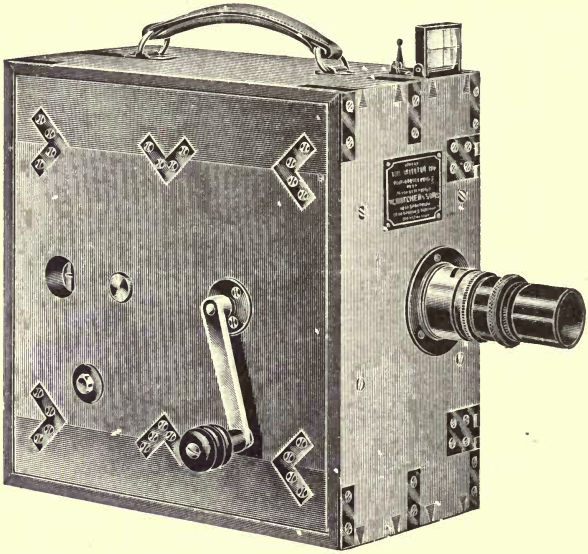


FIG. 3

WILLIAMSON TOPICAL CINEMATOGRAPH CAMERA, TYPE 7

The three main points in which a cinematograph camera differs from the ordinary optical apparatus employed for taking photographs are : (1) the provision of a shutter, operated by the handle, which automatically opens and closes the lens aperture so as to give a rapid succession of definite exposures on to the film which is passing through ; (2) a spring-gate, which holds the

film close to the lens aperture ; (3) one or more sprockett wheels, which are also operated by the handle, and the teeth of which engage in the perforations in the sides of the film and draw it evenly from (4) the loaded, or supply box, and, after exposure, pass it on to be rewound in (5) the unloaded, or take-up film-box.

The details of these essentials, as well as of the subsidiary mechanism, will be more easily understood by taking, first, the Williamson British-made " Topical " cinematograph camera shown in Figs. 2 and 3, which is more simple in design and mechanism than the expensive instruments used in the great film-producing studios of Europe and America, and which can be more easily described when the essential features have been grasped.

The main idea of the manufacturers when producing this thoroughly practical little camera was to supply an inexpensive apparatus suitable for filming local events, and for out-of-door work generally. No essential feature was sacrificed to cheapness, the main differences between this and more elaborate apparatus being in the amount of film carried and in the extra conveniences and attachments necessary for fine studio work.

The camera, itself, consists of a polished mahogany case, brass-bound, with leather carrying handle, and measures $9\frac{1}{2}$ ins. by $4\frac{3}{4}$ ins., by $9\frac{1}{2}$ ins. in height. The lens and mount project another $1\frac{3}{4}$ ins., and the whole, when loaded with film, weighs only $7\frac{1}{2}$ lbs. It is provided with two film-boxes, holding 100 ft. of standard sized film.

The general arrangement of the mechanism in the mahogany case, and the path taken by the film, will be clearly seen in Fig. 2. The eight-picture sprockett *A* is turned direct by the handle. The loaded film-box *B* is placed on the top of the receiving box *C*. The path the film takes after leaving the top box is, under the

fixed roller *D*, and, after engaging with the teeth of the sprockett, under the spring roller *E*, lifted by the finger clip *F*, and after forming the free loop *G*, through the spring gate *H*, then forming another free loop *I*; under the sprockett again and held in position by the

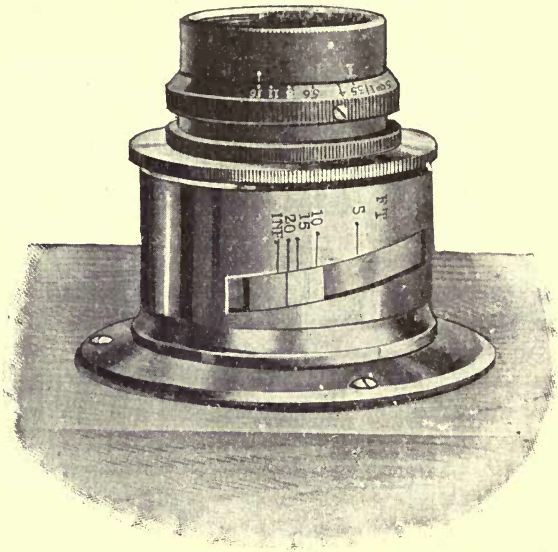


FIG. 4

COOKE ANASTIGMAT LENS IN FOCUSING MOUNT FOR "TOPICAL" CAMERA

spring roller *J* and fixed roller *K*, then under the fixed roller *L*, and finally through the velvet-lined slot into the receiving box, the end being fixed to the centre bobbin *M*. The claw *N* is shown in the "out" position, in which position it must be placed by turning the eccentric disc *O* when threading up the film. The Shutter *P* is recessed in the case, and the whole of the

mechanism is built on a skeleton casting, so that by the removal of four screws it can easily be detached from the case in one piece.

The lens (see Fig. 4) is a 2-in. Cooke anastigmat, working at $F/3{\cdot}1$. The focusing mount is a simple 2-tube sliding arrangement, easily operated by the milled ring R, and graduated for *infinity*, 20 ft., 15 ft.

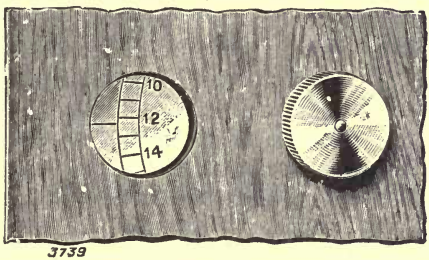


FIG. 5

INDICATOR FOR REGISTERING LENGTH OF FILM EXPOSED

10 ft., and 5 ft., by the spiral slot Q. The *iris* diaphragm is operated by the milled ring S; and on the lens mount is a detachable sun shield T, which screws into the front of the lens.

An indicator for measuring the number of feet of film exposed at any moment during operation is fitted. Fig. 5 shows the indicator window, which is in a convenient position on the handle side, and near by is a knob for resetting to zero when charging the camera.

A more recent model of this type of camera is now being made (Williamson, Type 7) and will have the following improvements: (1) greatly strengthened mechanism, by the fitting of double bearings to the main shafts; (2) increased film-carrying capacity (200 ft.); (3) a film measurer; (4) a new focusing

mount with a 2-in. $F/3{\cdot}1$ Aldis-Butcher anastigmat lens ; and a finder fitted into the body. This camera will be capable of the highest class work, and at the same time be light and portable (Fig. 3).

So far we have dealt with the simplest form of cinematograph camera—the topical—which, as its name implies, is more suitable for straightforward outdoor work, in which weight is an important factor, than for the more complicated studio or trick photography.

The Williamson cinematograph cameras, types 3, 4, 5, 6, 7 and 8, are, however, for use by professional cinematographers for both indoor and outdoor work, and in general design are similar to those in use by nearly all British and foreign film producers.

The professional camera consists of a mahogany box measuring 14 ins. in length, by $5\frac{1}{2}$ ins. in width, and 15 ins. in height, with brass protecting corners and leather carrying strap. The supply and take-up boxes, which are enclosed in the mahogany case, each hold 330 ft. of film. There is a focusing tube from the exposure window to an aperture in the back of the case ; and by means of a four-picture continuous movement sprockett, for both feed and take-up, with free loop on either side of pressure gate, a steady passing of the film is assured.

This type of camera is fitted with every refinement, such as a *film-punch*, with which to mark the beginning and end of different subjects by punching a hole in the film ; a *measurer*, showing at a glance the length of film exposed ; a *two-speed device*, for eight pictures and one picture per turn of handle ; a patent *claw movement*, insuring smooth and quiet running even when the handle is turned at the rate of thirty-two pictures per second ; a method whereby the film can be *reversed* and re-wound into the top or supply box for trick

photography (such as the reversing of traffic in a street scene) ; a *speed indicator*, showing the feet per second at which the film is being exposed, a detachable box *view-finder*, two interchangeable *film masks* for trick work (such as a view through binoculars or key-hole) ; and a variety of tools and spare parts.

The lens generally used is a Cooke anastigmat of 50 m/m, focus $F/3{\cdot}1$, in a rack mount ; but Dallmeyer and Ross Xpress lenses are also very frequently fitted. The price of these cameras complete varies according to type from £70 to £100.

We now come to what may be termed a British made super-cinema-camera, the Williamson " Paragon," which should certainly satisfy the requirements of the most exacting studio photographer, and is yet so light, compact and durable as to be eminently suitable for the topical camera man and the traveller or explorer in torrid zones or regions of perpetual snow.

It is an acknowledged fact that sooner or later all cinematographers need to use their cameras for almost every conceivable purpose, and it was with this comprehensive object in view that the " Paragon " was designed. Although exceedingly simple in form it incorporates innumerable devices and movements for every possible requirement. The main features may be summarized under four headings : (1) all the controls are placed at the back of the camera immediately in front of the operator ; (2) three lenses are provided, and are fitted on a detachable turret, each of these lenses can be focused without disturbing the film ; (3) the case is made of seasoned teak wood inlaid with brass to prevent warping and lined with sheet aluminium as an additional precaution ; and (4) automatic dissolving can be accomplished by shutter or iris-diaphragm, or by both simultaneously.

The brief enumeration of these improvements on previous models is, however, not sufficient to enable a true understanding to be obtained by the non-technical reader of the completeness and yet mechanical simplicity of this up-to-date apparatus, and a more detailed

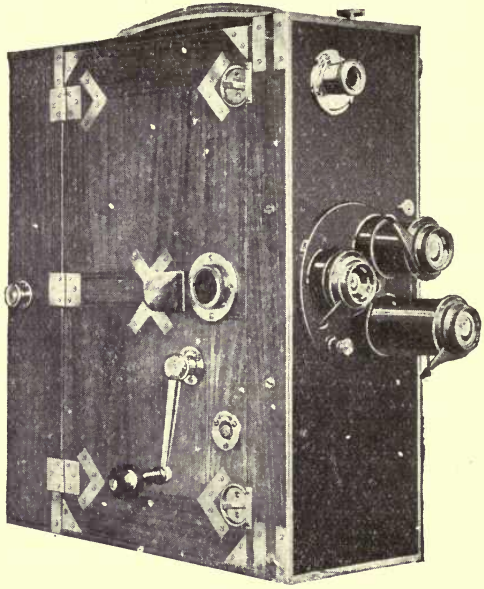


FIG. 6

THE " PARAGON " SUPER-CINEMA CAMERA

description together with an illustration seems therefore to be warranted here, notwithstanding the necessity for rigid economy of space.

Fig. 6 shows the front and handle side of this fine camera. At the back are nearly all the dials and controls used when operating, as well as a magnified image, seen through an opening in the case, of the

actual view being photographed. First among these handily-placed controls comes a speed indicator giving the number of pictures being exposed per second. The next dial is a measurer, the large hand making one complete revolution for each 100 ft. of film exposed, and the small hand indicating the number of hundreds. These hands may be set to zero by a small centre knob. The bottom dial indicates the actual exposure of each picture at the normal speed of sixteen pictures per second ; the hand revolves when dissolving by means of the automatic attachment, and this shows the speed of dissolving and when the picture has been " blacked out." Immediately below the exposure dial is a knob for setting the opening of the iris diaphragm or vignetting device. The actual position and diameter of the iris may be seen in the view finder, and adjusted if required to dissolve in any part of the picture by the knobs on the top and side of the camera. To the right of the iris knob is a small lever for throwing the automatic gear into mesh for operating the vignetting device, whilst to the left is a similar lever for actuating the automatic shutter-dissolving. These levers may be operated either separately or together, the length of time taken to dissolve being pre-determined by the setting of the lowest knob. By this means the period may be varied so that the dissolves occupy 18 ins. of film, 3 ft., $4\frac{1}{2}$ ft., or 6 ft. of film.

All essential parts of this camera, including the film boxes, lenses, etc., are mounted entirely independent of the case, which is therefore used as a covering only. The carrying handle is attached direct to the mechanism plate, as is also the tripod socket. This method of construction enables the retention of a polished wood case, with its advantages of smart appearance, durability and weather-proofness, without the necessity of relying

on it in any way for supporting the mechanism or lens. The inside of the case is, however, lined throughout with thin sheet aluminium as an additional precaution against light-leaking under abnormal conditions.

All the moving parts are mounted on a flat aluminium plate which slides in grooves down the centre of the wooden case, thus dividing the case into two separate light-tight compartments. These moving parts are reduced to a minimum by correctly disposing the intermittent movement and sprocketts. By removing the handle, tripod socket, and half-a dozen screws in the front of the camera, the mechanism may be withdrawn intact for cleaning, adjustments and inspection.

The film-boxes are placed vertically one over the other and have hinged doors and interlocking mouthpieces. They hold 400 ft. of film on large diameter centre bobbins without the necessity of tight winding. An important feature is that both sides are flat with absolutely no projections. A centre hollow trunnion supports the film, but is quite independent of the drive, which is carried in the camera mechanism, and projects through the box direct to the film bobbin. The box itself is not clamped in position, but registers on the driving boss. In this way strength, combined with easy running, is obtained in a similar manner to the live axle of a motor car.

For rewinding and reversing, the power is transmitted from the main gearing through a triangular chain-drive to the two film-box centres. Ten degrees movement of the turning handle in either direction is sufficient to actuate the automatic clutches in the top or bottom drive. In this way the film can be rewound in either box by merely reversing the direction of the turning handle, without any slack in the film. The tension of the take-up is easily adjusted by a single brass knob

which varies the pressure on large fibre washers, and is so designed as to eliminate end thrust, and to transmit the drive with a minimum amount of " slip." Accurate adjustment of the chain is provided for by swivelling the lower chain wheel, without disturbing the film-box drive.

The gate and intermittent movement is similar to that described in previous pages, and is a characteristic feature of all the Williamson cameras. The film is held central with the exposure aperture by a spring side runner in the focal plane. The claw movement is devoid of springs of any kind, and the teeth are shaped to enter the perforations in the side of the film without friction. An unusually large diameter fly-wheel, running on ball-bearings, assists the even turning movement.

Three different lenses have been mounted in a revolving turret (see Fig. 6). A separate aperture is provided so that the lenses may be focused direct on an optical screen by means of a magnifying lens fitted in the right-hand door, without disturbing or fogging the film. Either of the lenses may be quickly turned into position and locked by a spring bolt. The turret itself is detachable by a single spring catch in the centre.

The shutter is driven through spiral gearing provided with double adjustable ball thrust washers. The shutter spindle carries separate leaves for varying the aperture. This variation can be accomplished, while the camera is being operated, by a conveniently situated lever. The exposure is indicated on a dial at the back of the camera.

For what is technically known as " spot " dissolving and vignetting two iris mounts are fitted ; one immediately in front of the exposure aperture, and a larger

one for the view finder. These mounts are coupled together and fitted on a universal frame movement, which can be operated by two knobs on the front of the camera. Both irises are operated together by a small lever on the back of the camera, which automatically connects a ratchet and crank to a cam on the shutter spindle. The speed of dissolving is varied by the position of the operating lever. By this means the picture may be dissolved to any desired size in any part of the mask, and viewed at the same time.

Among other refinements may be mentioned the fitting of the turning handle to the mechanism inside the camera case by a bayonet joint, which enables turning in either direction ; the interchangeability of the masks in the view-finder and exposure aperture ; the fitting of the lens for the view finder in a focusing mount on a slide with an indicator plate ; the supply of two hands to the measurer, thus showing accurate footage ; and the provision of two speeds, (eight pictures and one picture) for every turn of the handle.

There are, in addition to the British made .varieties just enumerated, many other makes even more extensively used in the studios of the United States, France, Italy, and other foreign countries, but the essential characteristics of all are similar, and lack of space prevents more than a passing mention of these being given in this little book, which is intended more as a guide to the *industry* than as a text book on cinematography.

Foreign makers of cine-cameras had a long start, owing to the more rapid development of the whole industry in countries like France and the United States, and they now produce some very fine but costly apparatus. Messrs. Pathé Frères' cameras are of world-wide repute, as also are those of another French firm, *Debrie*

("Parvo"). The United States has various types, several of which are as near to perfection as the present position of science will permit.

There are also several designs specially adapted for scientific and other purposes. During the Great European War aeroplanes used for scouting purposes were fitted with a special type of cinematograph camera for filming enemy positions, and the screen was largely used for the intensive training of both officers and men.

In the realm of natural history effective use is being made of cine-cameras fitted with telephoto lenses, by means of which wonderful films of birds and animals in their natural surroundings are being obtained. The telephoto lens is also used for filming scenes on mountains, glaciers, and for photographing far-distant objects. In this way the cine-camera has been provided with a telescope, enabling scenes to be afterwards depicted on the screen which actually occurred at a considerable distance from the eye of the camera.

With the aid of an *Ultra-Rapid* cine-camera all movement is *slowed* down ten times, and films taken with this apparatus showing a stampede of wild cattle, charging cavalry, athletes running, jumping and swimming, clearly depict, when thrown on the screen, the graceful movements of the body of both man and beast, and the play of each muscle—much of which is quite invisible to the slow-working human eye.

Tripods, Revolving Heads and Tilting-Tables. It will be apparent to the thoughtful reader that a camera making exposures at the rate of about 960 separate pictures a minute by the turning of a handle on the outside of the case requires a very firm stand or tripod to hold it steady while being operated. The study of almost any film when projected on the screen will also reveal the fact that the cine-camera must possess a

revolving head, to enable the lens, or eye of the camera, to be turned to right or left while the picture is actually being taken in order to follow the movements of, for example, a horseman or train passing at right angles to the camera ; and, furthermore, a *tilting-table* has also to be provided, by means of which the eye of the camera can be elevated or depressed to catch a rising or dropping object, such as an aeroplane leaving the ground or a man falling over a cliff.

These two movements, the horizontal and the vertical, are provided for, not in the camera itself, but on the tripod or stand upon which it must be mounted for all practical purposes.

The tripod or stand often varies considerably. What is practicable in a studio is often far too clumsy and heavy for field work. The essential is, however, always the same, viz., to provide a rigid stand upon which to operate the camera. When a whole outfit has to be carried to the top of a mountain, into the crater of a volcano, across hundreds of miles of frozen sea, through tropical jungles and over swamps, it will be readily understood that extreme lightness, combined with rigidity, is the dominating factor to be considered. Hence, for topical or field work the legs of the tripod are usually detachable and provided with a telescopic adjustment, whereas for studio work, either a very substantial stand running on wheels, or a tripod of polished ash, adjustable in height from 3 ft. 6 ins. to 6 ft. 6 ins. is used.

Upon the top of the tripod or stand is fitted the revolving head, generally composed of an aluminium base-plate with steel working parts. A handle with gears and spindles enables the operator to swing the camera steadily round on the horizontal plane, and so keep the " eye " directed on to the object being filmed.

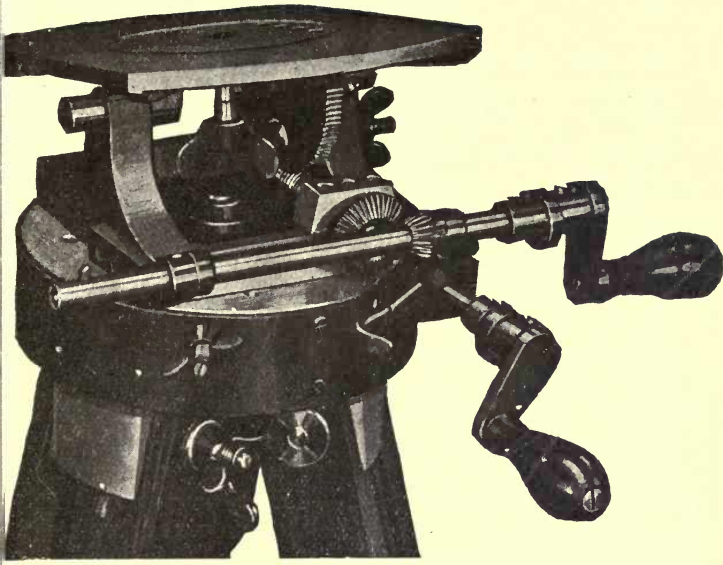


FIG. 7

"EMPIRE" TRIPOD WITH REVOLVING HEAD AND TILTING TABLE

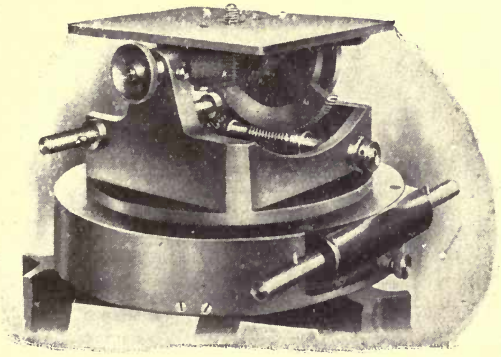


FIG. 8

"GIBRALTAR" TILTING HEAD, SHOWING MECHANISM

The gear can be thrown out entirely if desired, thus allowing the camera to be instantly turned on to another object. A clamping screw and winged nut is also fitted to hold the camera in one particular position when necessary.

The tilting-table is an entirely separate device which can be fixed between the camera and the revolving head of the tripod in a few seconds. Whereas the revolving head, which usually forms part of the tripod, allows the operator to follow an object in a lateral direction, the tilting-table, as its name implies, allows him to direct the camera at an ascending or descending object. It consists of a base-plate and support, made of aluminium, with gears and spindles for tilting the table on to which the camera is fixed by means of a central screw operated from the side.

The comparatively simple mechanism of the revolving head and the tilting-table will, perhaps, be more readily understood with the aid of Figs. 7 and 8, showing the apparatus made by the Williamson Cinematograph Company, of London.

CHAPTER III

PERFORATING, DEVELOPING AND DRYING

BEFORE the negative film can be used in any camera it must be perforated along both edges by a continuous series of very accurately punched holes. These holes cut in the film enable the teeth of the sprockett wheel (part of the camera mechanism) to engage and draw the film steadily from the supply-box, past the lens aperture (for the exposure) and re-engage to pass it equally as steadily back to the receiving box. This action will be clearly understood from the description of the camera mechanism given in the last chapter.

It must be pointed out here that this system of moving the film by teeth engaging in holes on both sides is practically universal, and applies not only to the negatives used in the camera, but also to the printed film used in the projector which throws the pictures on to the screen. In fact it is by the perforated edges that almost every film is passed through many of the different processes of manufacture and finally through the projectors in the cinemas.

Thus, before the negative film is placed in the camera it must have perforated edges, and when exposed, developed and printed, each copy made from the original must also be perforated. The machine which actually punches the holes in the thousands of feet of film copy which result from the production of one good original is, therefore, not only an important piece of industrial mechanism, but is also a very hard-worked unit in almost every film-making factory.

The mere punching of holes in a comparatively soft substance such as film-stock may sound an easy mechanical proposition, and it can be said with truth that the actual work is by no means difficult, but upon the accuracy of these holes depends in large measure the steadiness of the picture when finally thrown on to the screen. It has been said that the most perfect film in the world is more or less unsteady, according to the quality of the projector, but even the most perfect projector will not show a steady picture if the machine employed for perforating the film has not done its work properly. It is therefore of the utmost importance that the perforator should be as accurate in its work as is mechanically possible. The ideal machine should work so truly that when a film which has been passed through it once is reversed and re-perforated there is no enlargement of the holes in any direction.

It is obvious that if a film is to be used in hundreds of different projectors during its full life, and that its successful passage through each of these depends upon the accuracy of the perforations, there must be a *standard* for all machines, cameras, projectors, printing machines, and films, regardless of the maker. The English standard is sixty-four holes to the foot.

There are several different types of perforating machines on the market. Some punch only two holes at a time and others as many as eight. The latter type are made by the Williamson Company and perforate the eight holes required for each little picture at one time (see Fig. 9). This four-fold increase in speed is an important factor in production owing to the phenomenal growth of the cinematograph industry during recent years and the consequent strain on all classes of machinery. The average output of these perforators when running at the normal speed of 300

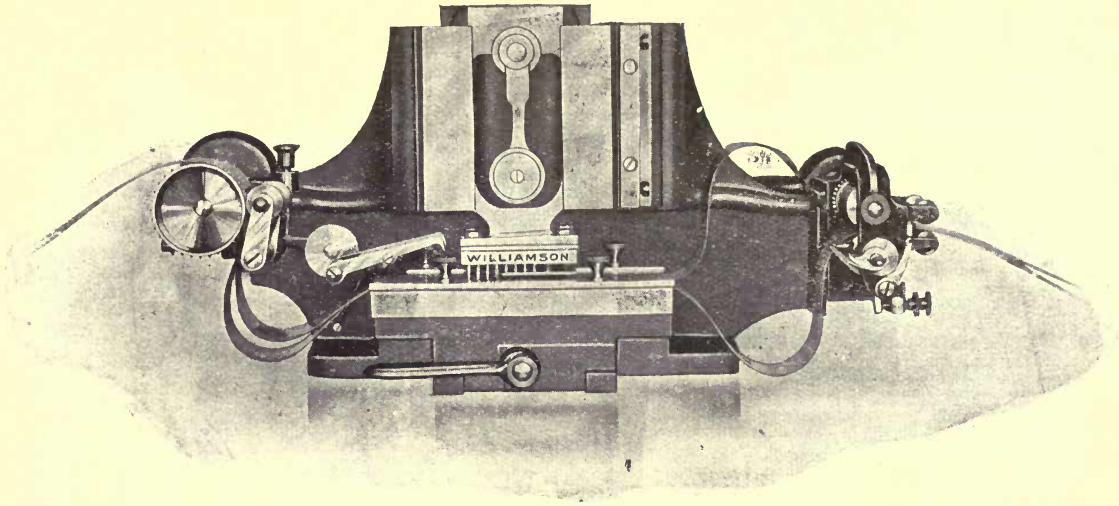


FIG. 9

A WILLIAMSON FILM-PERFORATING MACHINE

revolutions per minute ($\frac{1}{10}$ H.P. motor) is 2,000 ft. of film per hour.

Developing Devices and Drying Drums. When a roll of negative film has been exposed in a cinematograph camera it must be developed in the ordinary

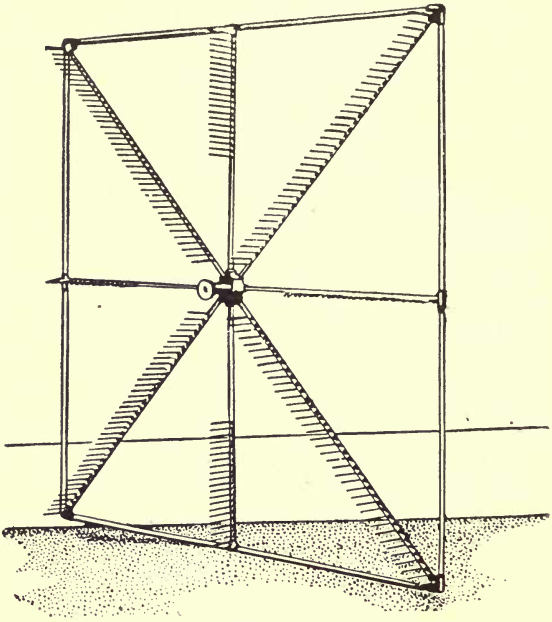


FIG. 10

PIN FRAME FOR DEVELOPING CINEMATOGRAPH FILM

way. Instead of a few inches of film having to be passed through handy-sized developing dishes there is, however, a continuous length of about 330 ft. with approximately 3,900 little photographs to be dealt with. Although each of these minute pictures—little

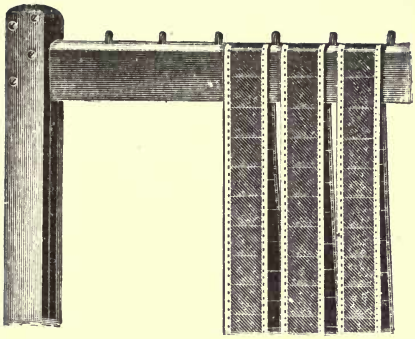


FIG. 11

FLAT TEAK WOOD FRAME FOR DEVELOPING CINEMATOGRAPH FILM

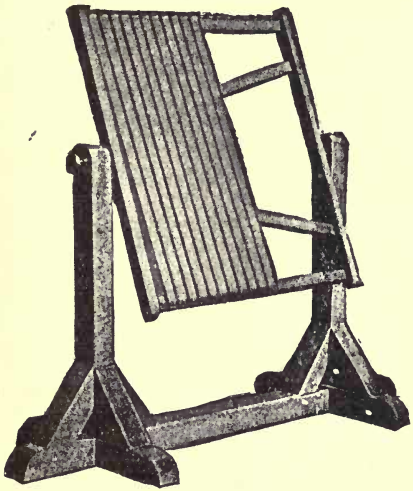


FIG. 12

WINDING STAND FOR DEVELOPING FRAMES

larger than a postage stamp—cannot be developed separately, they must be very evenly developed *en masse*, so as to bring out the enormous amount of microscopic detail on their tiny surfaces. All that is afterwards seen greatly enlarged on the screen must have its origin on the negative.

Although the process of developing a cinematograph film is similar to that employed for all other kinds of photographic work certain special devices are used to deal more expeditiously with the greater length of film presented.

When the roll of film is removed from the receiving-box in the camera it is either wound spirally on a metal *pin-frame* (see Fig. 10), or else wound over and over on a flat teak wood frame (see Fig. 11). Of these two methods, both of which take place in the dark-room, the pin-frame, being constructed entirely of brass, has certain advantages, as it occupies much less room and uses less developing solution, but the time taken to wind the film round the pins projecting from the tubular brass frame is much longer, and great care has to be exercised in order to prevent damaging the emulsion on the pins. For these latter reasons the wooden frames, although they require larger chemical sinks and more room for winding, are usually employed in the developing rooms of big factories.

To facilitate winding on the frames, a stand, into which the frames can be fitted and afterwards turned over and over, is used (see Fig. 12). The top and bottom bars of each frame are fluted to allow a free passage of air beneath the film when the frame is used for drying. Brass staples prevent any possibility of damage to the emulsion or fear of overlapping. The size of the frames necessarily varies according to the dimensions of the chemical sinks into which they must conveniently fit.

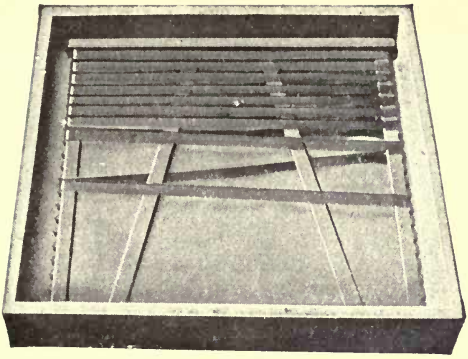


FIG. 13

DEVELOPING TRAY WITH CARGO OF FILM ON FRAME

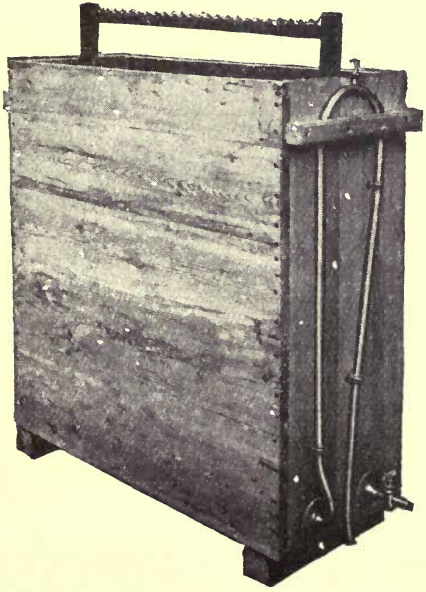


FIG. 14

DEVELOPING TANK, SHOWING POSITION OF FILM-FRAME

The standard sizes accommodate from 100 ft. to 200 ft. of film, and are a little over 3 ft. square.

Nothing need be said here about the developing, fixing and tinting trays or sinks for containing the

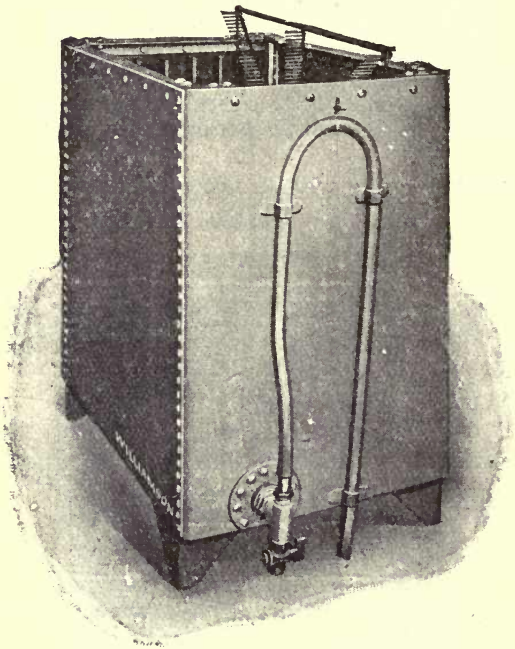


FIG. 15

WASHING TANK, SHOWING POSITION OF FRAME

chemical solutions into which the frames and their cargoes of film are placed for the ordinary processes of development. Fig. 13 shows one of these trays with its frame and film ready for immersion, and Figs. 14 and 15, a developing and a washing-tank.

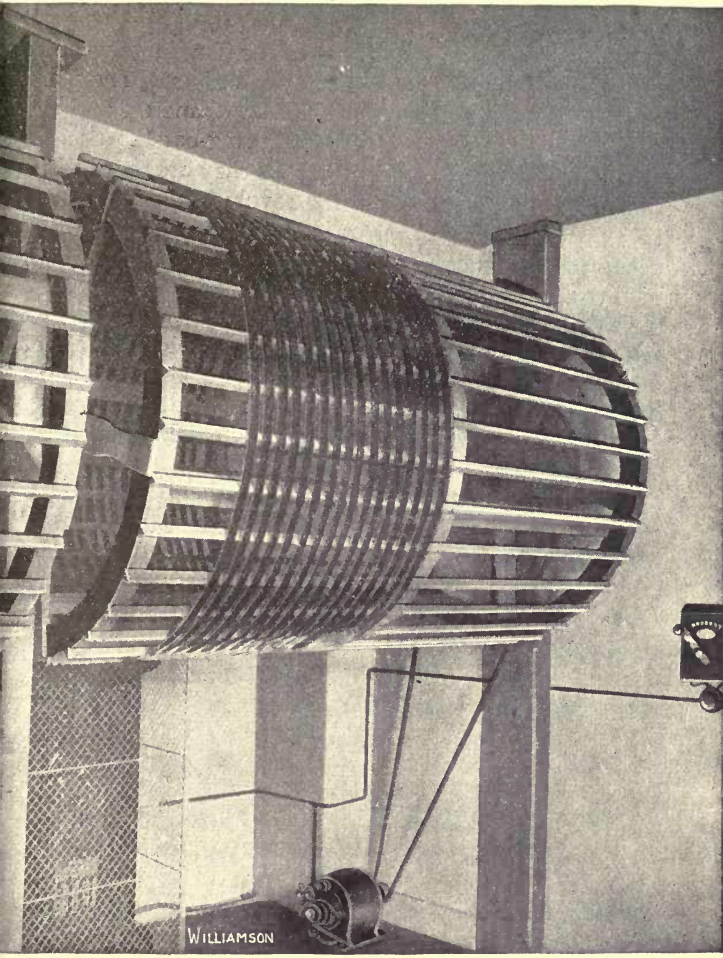


FIG. 16

M-DRYING DRUM. ELECTRICALLY ROTATED IN HOT-AIR CHAMBER

—(1463P)

When it comes to the drying of the film, large wooden drums have been found most convenient. They are usually about 5 ft. in length, 4 ft. in diameter, and are strongly made of deal with two spring-bars to accommodate shrinkage (see Fig. 16) As they are required to rotate at a speed of about 150 revolutions per minute, being driven by an electric motor, they must be accurately balanced, supported on a steel shaft, and mounted on ball-bearings.

Each drum holds about 500 ft. of film wound round its circumference, and in order to dry its load in about 15 minutes it is revolved in a special drying-room, the atmospheric temperature of which is raised, usually by electric radiators, to about 90 degrees Fahrenheit.

CHAPTER IV

PRINTING, TINTING, TONING AND TITLING

When the negative film has been dried on the revolving drums in the hot-air chamber it is a finished product, but not the finished product that is projected on to the screen, which is a *print* made from the negative. In order to obtain a print, or positive, ready for exhibition, the negative is placed in contact with another length of sensitized film and the two are then passed through a printing machine. Afterwards the final product is developed, fixed, and washed in the same manner and by the same devices as the negative film.

The printing machine is a very complete form of apparatus, and is contained in a cabinet of quite moderate size (see Fig 17). It is divided into two compartments. The lower one contains a small electric motor ($\frac{1}{10}$ H.P.), and a system of cone pulleys, by means of which four speeds may be obtained. Each of these four speeds is further controlled by a regulating switch giving six speeds. The upper compartment is lined with asbestos, and contains an electric lamp fitted on a slide, controlled on a quadrant of the front of the machine, by which the lamp may be moved any distance, from 2 ins. to 10 ins., from the printing window. This lamp is further controlled by a regulating switch, giving six variations of the light, from sixteen to fifty candle-power. This compartment is perfectly light-tight, and at the same time is efficiently ventilated. The mechanism is mounted on a brass plate, fitting a mahogany frame hinged to the front of the cabinet, and held by a spring catch. In this way the principal working

parts are protected from dust, and, at the same time, are out of the way of the travel of the film, but are easily accessible. A reference to Fig. 17, will make the details of this wonderfully complete machine quite clear even to the non-technical reader.

It may be of interest to briefly describe here the method of starting and working one of these machines. In order to *thread-up* the film the lever *H* must be moved so that the white light is cut off, then the negative film is placed on the top spool-holder and the positive on the lower spool, so that the two emulsioned surfaces are together. The top sprockett is fitted with a ratchet drive so that the two films may now be placed together over the teeth, and a sufficient length of film pulled down to reach the bottom sprockett. The gate is opened and the two films placed over the mask, care being taken that the teeth of the intermittent claw movement enter the perforations in the sides of the films. The gate is closed, loops of film being left above and below it. Attention is then given to the lamp, which is moved into the correct position by the lever *P*. The belt is shifted on the cone-pulleys in the compartment *O*, so as to give the required speed, and the levers are set on the electrical resistance *L*. These positions are determined by trial and experience. The light is uncovered by moving the lever *H*; and by holding the pulley *R* in the right hand and switching on the current at *N* with the left hand, the machine is put in motion. All that has now to be done is to release the pulley and guide the two ends of film on to the rewind spools.

The actual printing is carried on automatically, but when a varying density is required (1) the speed of the motor, (2) the intensity of the light, and (3) the position of the lamp, may be varied without stopping the machine. Any of these operations

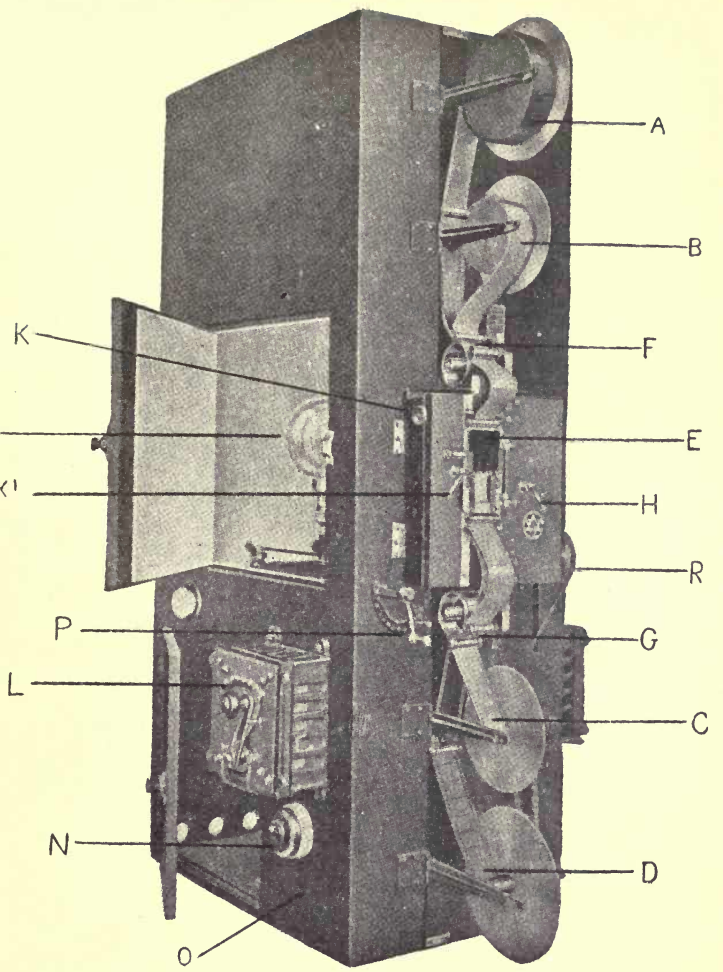


FIG. 17

WILLIAMSON STEP-BY-STEP PRINTING MACHINE

Negat ve film. B = Positive film. C = Positive film rewind. D = Negative film rewind. rinting gate. F = Top sprockett feeding film to gate. G = Bottom sprockett maintaining f film below the gate against the action of rewind. H = Lever to more red glass to light from film. J = Printing light (60-w. metal filament lamp) in asbestos lined rtment. K = Button actuating masking arrangement. K1 = Locking lever for mask. esistance to give 6 speeds to motor. N = Switch controlling electric supply. O = Com- nt containing electric motor and cone-pulleys to give 4 different speeds. P = Lever to move light. R = Driving pulley.

can be very rapidly carried out after a certain amount of practice.

When the positive film has been printed by the action of the light passing through the negative on to the sensitive emulsion of the positive, by what is known as the *step-by-step* method, the printed film is taken to the developing and fixing-rooms, and goes through the same treatment as that described in the previous chapter, after which, unless tinting or toning is required, it is ready for exhibition.

In addition to the very complete British machine just described there is a smaller edition, which has only one compartment (see Fig. 18). The electric motor is mounted on the top of the cabinet, and no rewinding spools are provided, the films being allowed to run into a divided receptacle placed below the machine. There is also a very simple device known as a "continuous printer," which is operated by turning a handle (Fig. 19).

In the United States several very elaborate printing machines are on the market, and other countries also are commencing the manufacture of similar pieces of cinematograph machinery; nearly all of which are, however, more or less similar in their main characteristics.

Among the many time and labour saving devices used in film factories may be mentioned the *printer-measurer* (Fig. 20) which can be attached to the printing machine, and duly records the number of feet of positive film printed; the *detector* (Fig. 21), by means of which the operator of a printing machine is immediately informed by the ringing of a bell or "buzzer" of the approach of a change in the printing density of the negative; the *film-cleaner* (Fig. 22), which although primarily intended for removing developing marks, and the like, from new films, is often used to give old films

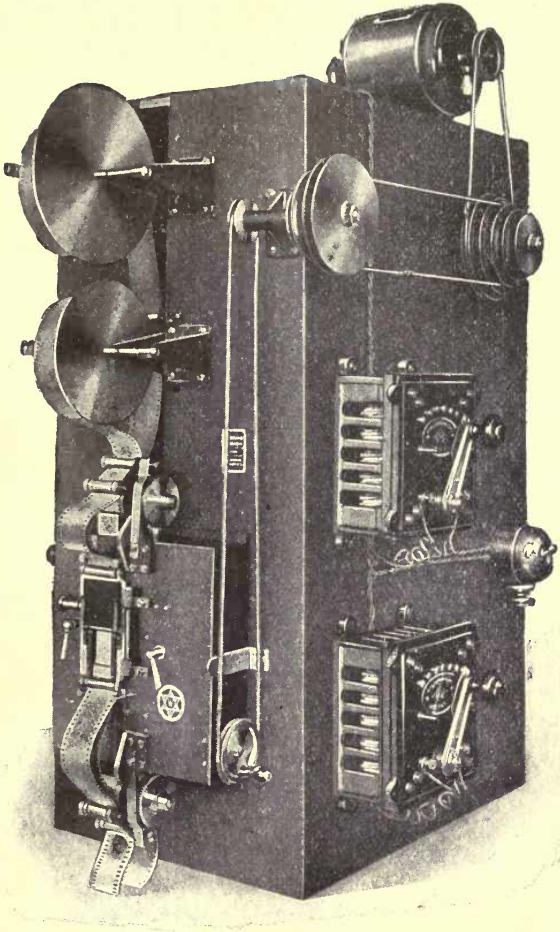


FIG. 18

FILM-PRINTING MACHINE WITH ONLY ONE COMPARTMENT (WILLIAMSON)

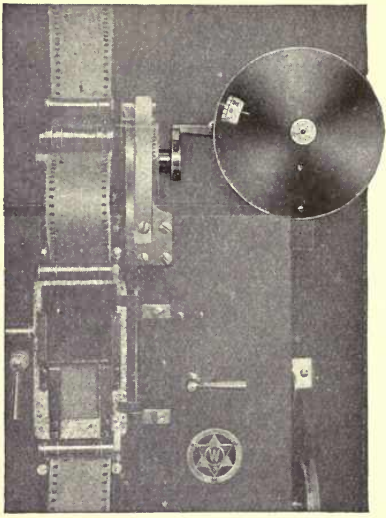


FIG. 20

WILLIAMSON'S PRINTER MEASURER ATTACHED TO FRONT OF PRINTING MACHINE

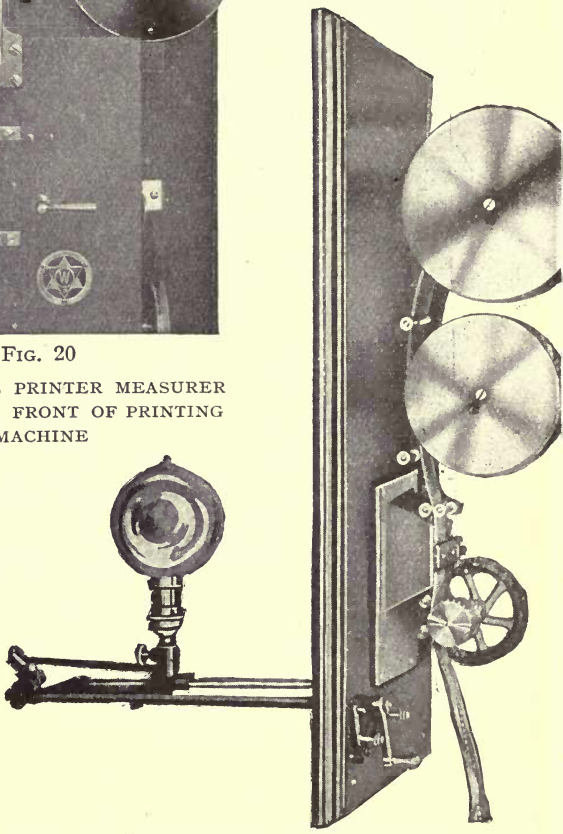


FIG. 19

THE CONTINUOUS PRINTER

a new lease of life ; and the *film-mender* (Fig. 23), quite a simple little piece of mechanism for holding and joining the two ends of a broken film.

It is perhaps advisable to point out here that many

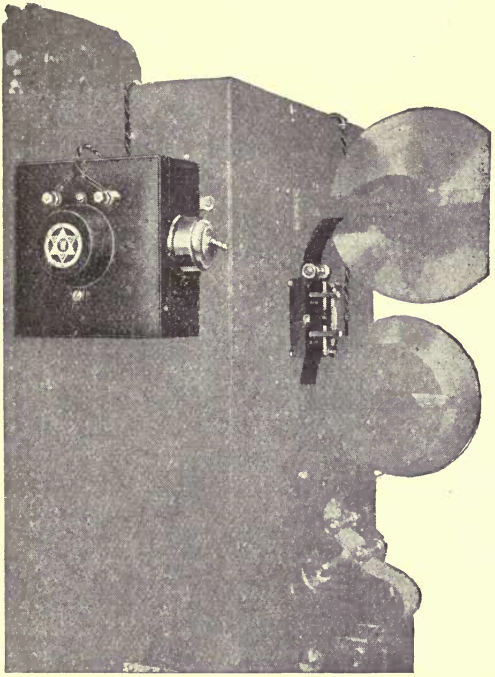


FIG. 21

THE "DETECTOR" FITTED ON SIDE OF PRINTING MACHINE

large film-producing factories have machines for special purposes which have been suggested by individual experience, and which do not form part of the recognized machinery of the industry. Film production in all its

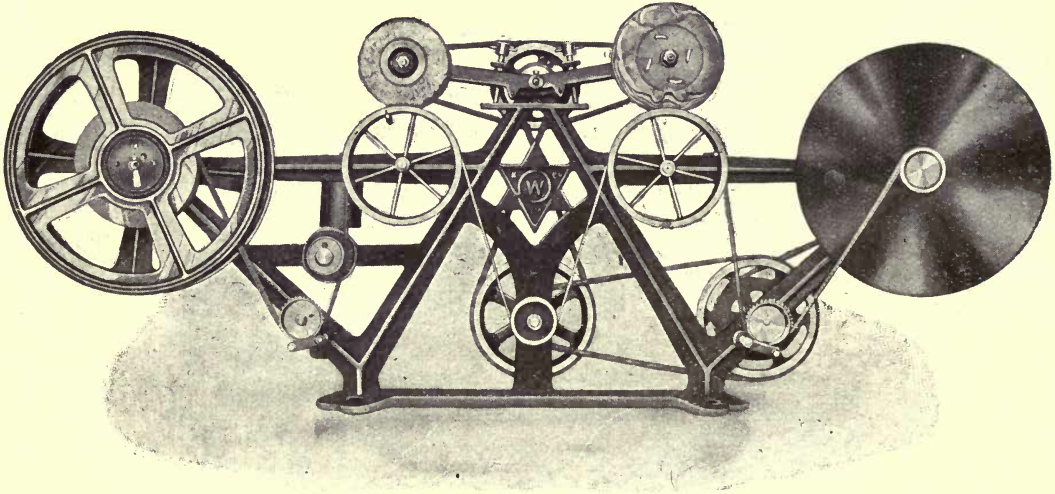


FIG. 22

WILLIAMSON FILM CLEANER

branches is relatively a new industry, and one of such phenomenal growth that inventors would do well to turn their attention to its many and diverse needs.

Tinting, Titling and Toning. Many films include scenes which, in order to obtain realistic effects upon the screen, need tinting with special water-soluble aniline dyes of varying shades. This occurs, for example, when a storm at sea has to be depicted. But this

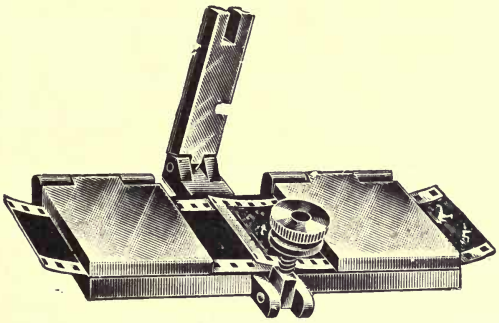


FIG. 23

"EMPIRE" FILM MENDER

process must not be confused with colour-cinematography. It is merely the artificial colouring of the gelatine on the surface of the celluloid film with one shade only, and has nothing in common with photography in natural colours.

Now, real storms are very difficult to photograph effectively, owing to the bad light which usually obtains during such atmospheric disturbances ; and even should the light be sufficiently bright to get a good negative—which might perchance happen once in an average year—the result, when projected on to the screen would not appear either wild or tempestuous if there were no heavy clouds. In order to remedy these shortcomings

of the camera and screen, a rough sea is photographed and a positive film is duly printed and developed, then it is immersed in a dye bath of blue-green, and the result when seen in the theatre is dank, wild and windy.

In order to give such a scene the proper atmosphere for its appreciation an art title is introduced, showing the words standing out clear from a painted background of threatening cloud and wind-lashed sea, stabbed by fork lightning.

This may be followed by a scene showing the calm which usually succeeds a storm—a derelict, abandoned, and floating idly on a moonlit sea—again the film must be dipped in a bath of dye, but this time no green is used, only a patent blue solution.

Changing to the collateral action in the succeeding scenes we see a sailor's wife playing with her children on a big, thick, and woolly rug in the cheery lamp-light. This time it is a pale orange-brown dye. If, in a later episode, the same children should see an apparition of their father during the night of storm, then a napthol green bath will produce the requisite weird effect.

As screen plays should, as a general rule, end happily we will continue our story and get back to the open sea. The survivors on a raft catch a glimpse of a sail in the light of early morning—a crystal violet solution—then as the sun rises to its zenith, flooding the sea with its golden light—brilliant yellow bath—the exhausted seamen are hauled aboard a glistening white liner, but late the following night disaster again overtakes them. The dreaded cry of " Fire ! " is followed by the crowding of passengers and crew into boats. The night is turned into a blood-red dawn by the burning ship—brilliant yellow and rose bengal—but again a rescuing ship comes with the morning, and the sailor returns to the bosom of his family.

It may be remarked here for the guidance of scenario aspirants that such a scene-plot would probably produce blasphemous-hysteria in the soul of any sane producer, and the effect might be even worse in the chemical laboratory.

The toning of a film is a totally different process, the aim of which is not to stain the gelatine coating, but to tone the photographic images on the film a certain shade, such as sepia, blue-grey, or brownish-red. This is carried out by immersing the parts of the film to be toned in various chemical baths, then washing them in water. The chemical composition of the baths for the various shades is a matter entirely beyond a general treatise such as this, and the process is one which can only be done satisfactorily after considerable experience.

Titling a film may be done in several different ways. The most usual method, and perhaps ultimately the simplest, is to have the words printed in block letters on a card, which is then photographed with a cine-camera fitted with a *reversing lens*. If the ordinary lens was used the title would be unreadable owing to the letters being the wrong way round when projected on to the screen. Another method, known as *plate-titling*, consists of making, by ordinary photography, a transparent plate with the words of the title in black letters. This plate is then placed in a specially made optical apparatus somewhat resembling a magic lantern, and the letters on the plate, acting in the same way as a lantern slide, are projected *in miniature* direct on to positive film being passed through the gate of an ordinary film-printing machine (*q.v.*).

These methods give film titles with white lettering on a dark ground, and thus avoid the glare which would result from a white screen with just the black letters thereon.

CHAPTER V

A MOTION-PICTURE STUDIO

A MOTION-PICTURE studio, to be deserving of the name, is a large and lofty structure of glazed glass. The size may be anything up to, or even beyond 100 sq. ft. of floor space, and the height is seldom less than 25 to 30 ft. The sides, up to about 4 ft. from the floor, are frequently constructed of brickwork, and one end of the whole building, where the cameras stand, may or may not be completely covered in. The remainder of both sides and roof is of glazed glass suitably shielded from the direct rays of the sun by a number of carefully arranged awnings, fitted inside the studio, which can be easily pulled across to diffuse the light.

In summer the interior should be well ventilated by electric fans, because of the heat generated from the sun shining through glass, and in winter it requires to be warmed by electric radiators, if the geographical situation or altitude makes the atmosphere cold. Without this attention to comfort film actresses and actors could not be expected to reach the high standard of dramatic art required for good motion-pictures.

The artificial lighting, which plays such an important part in the taking, or *filming* as it is called, of motion-pictures when the natural light of day is unsuitable, is sometimes accomplished by means of a number of enclosed long, or violet electric arcs, but in the large American studios Cooper-Hewitt mercury vapour tubes are generally used. As many as 300 of these being employed in banked formation to illuminate one large stage.

The glow from electrified mercury vapour is much cooler, softer, and more evenly diffused, than the light from arc-craters, which is often so glaring that studio-workers become temporarily blind. There are, however, special photographic arc-lights which almost equal the mercury vapour tubes. The amount of electricity consumed in order to effectively light one large stage setting may at times amount to as much as 50 H.P. converted into current.

A combination of mercury vapour tubes for the ordinary illumination with violet arcs to give concentrated beams or "spot" lights when it is desired to reproduce the effects of the sun's or moon's rays (afterwards tinted) shining through or upon an object, is, however, the usual installation in large studios (*see Frontispiece*).

Nearly all scenery for motion-picture work is painted in varying shades of brown for dark effects and grey or stone colour for the lighter shades. This destroys much of the artistic appearance of a setting when seen with the human eye, but is far more simple and satisfactory for the purposes of photography. The same applies to certain stage effects, such as fireplaces, window-frames, curtains, carpets, etc. Objects which appear genuine and solid when shown on the screen may be only shells, or half-shells, constructed of cardboard or papier-mache. On the other hand, the more solid kinds of furniture are usually genuine, and many studios have special store-rooms filled with antiques, Oriental weapons and curios, and objects of art.

It may be incidentally mentioned here that the facial make-up of artistes for screen work is also entirely different from that required for the ordinary stage. It is much more subtle, because of the absence of colour in the photographic result: experience alone can

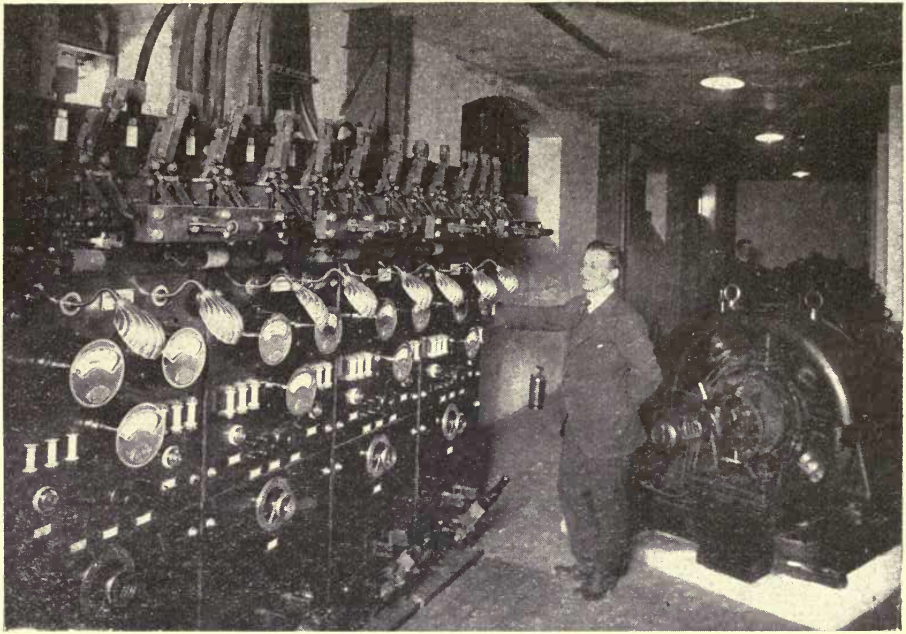
teach its intricacies. A creamy screen-complexion is generally obtained by a coating of yellow grease paint ! Deep-set, sorrowful eyes by heavy blue-black shadows ! Tears are frequently the result of an application of oil or glycerine, and volumes of *black* smoke may be produced by the *white* steam from boiling water !

The erection of an average set, or complete scene may take from two to twenty days, because of the careful way in which the flats, or different parts of the scenery have to be joined together in order to appear realistic when viewed through the critical eye of the camera. The actual filming of the same set is, however, generally accomplished in, from thirty seconds to two minutes, after which, if there are to be no *re-takes*, the elaborate scene upon which so much artistic skill, care and labour have been bestowed, from the embryo sketch of the Art-Director to the final touches of carpenters and scene-painters, is ready for rapid demolition, because its sphere of usefulness has ended and the studio is, in all probability, required for another building with a life of utility equally as short.

The frames for holding the mercury vapour lights are arranged, whenever possible, over the top of the scene to be photographed, in the form of a glowing roof, but a few portable ones are placed in front, and also, when suitably shielded from view, at the sides. The glare, although softer than when arc-lights are used, is very trying to the eyes.

For studio work the camera handle is turned by a small electric motor, of about one-sixth or one-eighth of a horse-power, possessing facilities for a very fine adjustment of the speed ; and the film-boxes are larger than those used for scenic or topical cinematography.

Attached to the studio are dark-rooms for developing, drying-rooms, printing-rooms, chemical laboratories,



THE MOTOR GENERATOR ROOM OF THE FAMOUS PLAYERS-LASKY BRITISH STUDIOS

scenery lofts, stage furniture depositories, scene-painting studios, carpenters' shops, dressing-rooms, engine-rooms for the electric supply, extensive grounds for outdoor sets, gardeners' sheds, offices, and many other departments of a modern motion-picture city.

When a scene, or *set* as it is called, has been finally completed, and the artistes are ready, the Director gives the word of command, "Ready! Lights! Camera!" and in a few brief seconds hundreds of feet of negative film have been run through the electrically-driven cameras. One out of a probable hundred scenes, if the picture being taken is a five-reel drama, is then finished so far as studio work is concerned.

CHAPTER VI

FILMS AND FILM-MAKERS

UNIFORMITY is a technical impossibility in cinematograph film production. Every motion-picture could tell its own story of difficulties overcome by individual effort and resource ; and no two films have ever been produced exactly alike. Method, time, place, light, space, subject, and a host of other varying factors must all be so dove-tailed, each with the other, and suited in general plan to the subject being filmed, that weeks of work and much foresight and power of conception on the part of the producer, or director, and his staff of experts, lie between the writing of the scenario and the turning of the camera handle.

The taking of a really important cinematograph film, such as Mr. D. W. Griffiths' masterpiece, *The Birth of a Nation*, can be likened to the organization and preparation required before even a small army can, with any degree of safety or possibility of success, advance into hostile territory. The whole plan of action, with its countless intricacies, must be original, complete, and have the maximum number of chances in its favour before the enormous financial cost is entailed.

It is not possible in this small book to do more than give a brief outline of the different types of motion-pictures seen in the electric theatres and lecture-rooms together with a synopsis of the methods employed in the making of them.

Before beginning the description of the actual work of production let us pause for a moment to consider the different types, or principal subjects, of the general run of films. First and foremost there is the drama,

the comedy and the farce, with the variations of each. These may be termed studio-films, because, although some of the scenes may be photographed in the open, they require studio settings for several acts, reels or episodes, and actors for all the principal characters. In other words they are *fiction-films*. Then comes the travel film, which may be placed in a class by itself, because, as a general rule, it requires neither studio nor trained actors, but relies on the beauties of nature combined with strange customs, dangerous feats of exploration, little-known peoples and places, or historic sites, for its subjects and its interest. Next comes the film gazette, which depicts actual and important public events of almost daily occurrence in one or other part of the world. It is the weekly newspaper of the screen, and relies more on central organization and its staff of cinematographers in the capitals of the world than on either scenery or acting. A variation of this type is the film magazine, which may be described as a screen monthly, and depicts, not just topical events in the great world of affairs, but interesting scenes and experiments, such as ski-ing in Switzerland, fishing with explosives in Borneo, and birds and beasts in their native haunts. Then there is the trick film, which may be an animated cartoon, traffic in a street moving at the speed of an express train, human beings running up the perpendicular walls of houses, or other result of trick photography. This type of film is, more often than not, of the studio variety, because actors and artificial scenery are usually required.

In the fourth category comes the purely scientific film, which may or may not be of interest to the general public. Here we have technical subjects of all kinds, naval, military, medical, chemical, astronomical, electrical, engineering, shipbuilding, and a host of others.

These films are seldom seen in their full length on the screens of the cinema halls, but their importance is considerable to the world of science, and they fill the seats of the hundreds of lecture-rooms of civilized countries.

So closely allied to the scientific film as to be, at times, almost indistinguishable from it, comes the purely educational picture. This branch of cinematography has, as yet, been but little exploited in Great Britain, because of the curious prejudice of educational authorities generally ; although films of this character were very largely and very successfully used for the intensive training of the great armies of England and America during the recent titanic struggle in Europe.

Finally, there is the propaganda and advertisement film. The former is, or should be, confined to national emergencies, and the latter usually depicts the making of an important universal or proprietory article, the busy scene in a great factory, or an interesting branch of applied science or art. This type of motion-picture has for its primary requirements ; (1) a nice judgment of what will, for a few brief moments, arouse the interest of an average cinema audience and yet not interrupt the ordinary programme sufficiently long to cause annoyance.

There are, of course, various other types of films, such as *kinemacolour*, but on careful examination they will, in all probability, be found to readily group themselves under one or other of these natural headings.

Fiction Films. This class of film, which is by far the most popular with almost every type of audience and in almost every part of the world, depends for its successful production upon a difficult combination of literary, artistic and dramatic talent, combined with organization and finance.

In order to obtain this combination of human ability without the chaos which so frequently results from divided counsels and authority there must be a "commander-in-chief," whose authority is supreme over all during the various stages of production. In the United States this "Admirable Crichton," whose power rests far more on tact than on force, is called the "Director," and in England the "Producer."

The financial side of film production is similar to that of any other large industry, with the possible difference that sometimes the "stars" working under the director are themselves the financiers, but recognize the absolute necessity of obeying the master creative mind while under the "arcs" and the fire of the relentless camera. At other times the director is the chief financier; and in perhaps the majority of cases the money is supplied by a group of business men, in the form of a permanent millionaire corporation, who are content to leave the actual work of selection and production in the hands of their chosen "general" and his staff.

The director must be a man of very considerable experience, talent for organization, knowledge of human nature—especially semi-neurotic feminine human nature—critic of acting, artistic yet businesslike, and possess alongside a super-abundant vitality the god-given power to command without becoming a mere bully. To this list of talents and virtues many others, such as patience, quickness of perception, memory, creative ability, resource, and strong will-power, might well be added without over-stating what is absolutely indispensable for the finest results in face of the world-wide competition.

The work of the director consists of chosing the scenario from those submitted to him by the scenario

editor, choosing his staff, actors and actresses, co-ordinating the work of the staff, watching rehearsals, approving and altering the setting of scenes, deciding finally the best locations for out-door scenes, giving the number and types of supers required—sometimes amounting to hundreds—and saying when and where their services will be needed. In fact preparing beforehand for every contingency probable and even remotely possible. All this may be termed his spade-work, which must be finished long before the cameras take up their allotted positions, the arc-lights are struck, or the mercury vapour glows with almost daylight-like intensity, and the orchestra for inspiring the actors begins its heart-stirring repertoire. For then he stands beside the battery of lenses, and, with the aid of a megaphone, orders, exhorts, beseeches, and inspires the actors, moves crowds of supers, watches the changing lights and shades, receives reports from the camera men, alters the tunes of the inspiring orchestra, and hushes the whole studio for some great climax so that in the death-like stillness, broken only by the whirr ! of the cameras and the hiss ! of the arcs the little figures on the big stage may feel the tragedy of the moment and respond with every movement of their limbs and every line of their faces to the call of their art.

At other times the same director will be flying over a cactus-covered desert on horseback shouting orders to a bunch of cattle-thieves being chased by cow-boys ; and a few months later directing an artificial avalanche in the Rockies, the dynamiting of a railway train, a dog-sleigh race within the Arctic Circle, a shipwreck, a Royal Court, a ball, a murder, a Parliamentary election, a dormitory scene in a girls' school, or the landing of the Pilgrim Fathers.

Then in the quiet seclusion of his study he will be

reading scenarios, novels, plots, studying the features of portraits, imbibing the "atmosphere" of a long past period, or foreign land, noting the most minute details with an eye to the possibility of exact reproduction.

The director's task would, indeed, be a difficult, if not impossible one, were it not for the assistance he receives from his staff of experts. Foremost among these comes the *scenario editor*, who reads the manuscripts sent in by playwrights, converts novels into picture plays, alters, makes additions to, or cuts out material from those accepted for production, elaborates a rough plot, and often prepares the description of the play for the publicity department. He must understand the type of play best suited to the particular "star" or "stars" available; have a thorough knowledge of screen technique, so as to cut out or alter scenes impossible to depict in a life-like manner with the apparatus or scenery available, modify those which would appear grotesque, and sharpen those which will stage effectively. Above all he must know what is novel in dramatic and humorous situations, what is "good-form," non-libellous, technically correct, copyright, and must himself be something of an author and playwright.

The art-director may be a well-known artist and he may not, but he must know all about stage scenery, interior and exterior decoration, period, art-photography, dress, light, shade, furniture, statuary, and how to obtain artificial effects. He must be able to design a scene from a few lines in the manuscript, such as—"Morning Room, Lochlevin Castle, Winter, 1747."

The art-titles are another speciality, and require something between a poet and a poster editor. It is comparatively easy to find a few words to describe a scene, but much more difficult to find the right words

to express an "atmosphere," and the difficulty would, to the average man or woman, become an impossibility when twenty or thirty such titles were required for one or more films every week.

It is quite possible for the author of a play to conjure a truly wonderful scene of tropical beauty, arctic grandeur, or temperate freshness, in which the creatures of his fertile imagination perform their heroic deeds of self-sacrifice, and such scenes may receive the blessing of the most exacting art-director, but it is the poor *location man* who, either from personal knowledge, photographs, or else rapid and intelligent search, must find some spot, not too far removed from the studio, or at least from civilization, which, with artificial aid, will resemble as near as may be the glowing description of an earthly paradise. As an instance of this the location man of a London firm was once asked at what point nearest to the metropolis could the following natural scene be found available for a company of actors—"A tropical garden, palm-bordered, through the feathery-fronds of which the sand-rimmed desert gleamed like burnished gold." The scene was required for the production of an Eastern play, and although artificial scenery could have been used, so important to the whole production was the true desert atmosphere that the whole company was transported for a few days acting to the interior of Algeria. On another occasion an old English bridge scene was required, and when at last the right spot had been found it was discovered that a telegraph pole and wires appeared in the picture when viewed from every available angle, so a scenic-cottage of the period was erected to hide the evidence of modernity.

Last, but by no means least, there is the cinematographer, whose work is, perhaps, the most scientific

and exacting of them all, for he cannot be sure until some time after the scene has been filmed whether or not he has secured a presentable picture. In the latter event the whole scene must be re-acted. As a guard against this, however, several cameras are frequently working at once, minimizing the risk of failure. It will be easily realized that the wasting of a few hundred feet of film is a matter of little consequence compared with the expense involved by the necessity of producing a scene twice over—perhaps one in which some hundreds of people and horses are engaged.

Another important position in the film-producing industry is that of studio manager. In all large studios there are store-rooms, filled with furniture of the artificial, or scenic variety as well as of the solid household type. Sometimes there is also a special fire-proof repository, filled with costly antiques and modern works of art. Then there are scenery lofts, with stacks of canvas wings, back-pieces, doors, windows, battens, curtains, etc., and studios for the scenic artists to carry on their work of altering existing scenes and supplying new ones. Next come the carpenters' shops, where staircases, scenery-frames, doors, tanks, scenic-houses, log-cabins, and a host of other temporary but very real looking erections are stored or made. The electricians department includes the dynamos and their driving engines, the transformers, the storage batteries, the tools for erection and repair, the frames for the mercury vapour tubes, the arc-lamps and carbons, together with miles of insulated wire. The civil engineers have the huge glass studios with their steel frame-works to keep in repair, the erections on which the actors may have to perform to test for safety, the drainage systems, lightning conductors, heating and cooling appliances, forges, water-supplies, and a veritable host of other things,

including the motor transport services, gas-engines, oil-engines, and fire appliances, to attend to. The dark-rooms, developing, drying, printing, and tinting rooms, all have their own staff of chemists and expert photographers. The cutting-rooms, the film editor and his cutters (about which more anon).

The publicity department is responsible for the "booming" of the stars and the systematic advertising of the films produced. Accountants carry on the financial side of these immense organizations, and the administrative work is done by the secretariat. Attached to such gigantic studios as those forming that great film-producing centre, "Universal City," there are houses for members of the stock companies and studio officials, garages for the cars, water and electricity supplies, schools and playgrounds, guest-houses, and, in fact, all the conveniences of a modern town. In this respect they can be likened to other industrial garden cities, such as "Kennilworth," which is the diamond suburb of Kimberley, founded by Cecil J. Rhodes; "Port Sunlight," Cheshire, of soap fame; and "Bourneville," the cocoa town.

Over a large section of these cinema cities—which at present exist only in the United States—the studio managers exercise the same control as the works managers of other industrial concerns. Their duties include the maintenance of order and cleanliness, the superintendence of the erection of scenic-streets, houses, palaces, gardens, fires, and other requirements of the director and his staff, as well as the care and disposition of the stage effects. Many studio managers say that theirs is a "dog's life," but very few retire early or die young, notwithstanding the high rates of remuneration paid to all engaged in film-production.

Little can be said here regarding the salaries and wages

paid to the different classes of workers in the film industry. They necessarily vary very considerably not only in the different studios (large and small) but also according to the country in which they are situated, and the degree of eminence to which the individual, in his respective sphere, has attained. It is, however, no exaggeration to say that a really well-known director or producer, can, at least in the United States, command a far higher salary than any Prime Minister in the world ; that an experienced and highly artistic cinematographer often receives far more in a year than an English Barrister with a good practice. That scenario editors and art-directors get salaries quite out of proportion to the receipts of the average journalist or artist ; and that those lower in the scale receive salaries or wages which make a startling comparison with those paid in similar professions and trades outside the cinematograph world.

As to the salaries earned by stars in the film firmament it is quite impossible to give any reliable statistics ; sufficient to say that more than one poor man and one poor girl have become the possessors of millions of dollars and princely incomes.

It should, however, be pointed out that success in the film world is far more difficult to attain than in almost any other great industry, owing to the keen competition, the somewhat " close " nature of each branch of film production, and the reluctance of directors to take the great risks consequent upon the employment of inexperienced people in any branch. Experience is often very dearly bought, and for every one that succeeds, especially on the acting side, hundreds and even thousands either fail absolutely or succeed only in making a bare living.

Much that has been said here regarding the high rates

of remuneration and the giant studios or cinema cities, refers to the industry in the United States, where it had made vast strides long before it was even regarded seriously in England. Furthermore, the climate of California, where many of the largest studios are situated, enables pictures to be taken out of doors and without artificial light, nearly all the year round ; and there is a wonderful combination of natural scenery, ranging from sun-scorched and cactus-covered deserts, palm beaches, and forests to modern cities and snow-clad peaks. Whether or not the film-producing industry will attain the same degree of development in Great Britain is problematical though quite possible. What appears to be far more likely is a levelling process in which several countries, including at least one or two of the British colonies, will become large producers, instead of a monopoly being held by the one nation which early in the history of the industry recognized its great future.

CHAPTER VII

FICTION-FILM PRODUCTION

UNDER the above heading may be included a very large number of operations which, however, are separate and distinct from the actual work of cinematography. They pertain, not to the actual taking of the pictures, nor to the development and printing of the films, but to the methods of arranging the cast and the setting of the scenes.

At this point in the description of the film industry it is necessary, for the sake of lucidity, to survey the ground already covered. It has been shown how the industry began and its recent phenomenal growth, the working of the camera and other apparatus used for producing the films, how the films, when taken, are developed, dried, printed, tinted, toned and titled, the general aspect and appliances of an up-to-date studio, the personnel of a film company, and the division of work and responsibility.

We now come to the choosing of the photo-plays or stories, the caste, the methods employed in the setting of the scenes, and the actual filming.

A *scenario* is neither a complete story nor a stage-play as these are understood in the literary world. It is the elaboration of a plot or theme written in such a manner as to be the foundation of a photo-play.

Dialogue is not often used when writing the first scenario of a screen play, although it is frequently afterwards employed where it is intended that the movement of the lips of the actor or actress shall be photographed so that when the picture is thrown on

the screen the few words actually spoken can be more or less gauged from the situation combined with the inherent ability to lip-read by the audience.

When setting down a screen-play the title is written first, then the caste and a brief synopsis of about two or three hundred words, which contains the essentials of the entire play. Then comes the list of scenes, with exteriors distinct from interiors, so that the editor or producer may see at a glance which scenes must be set in a studio, and the type of scenery required for the out-door locations. Each scene contains only one main incident having a direct bearing on the story, for it must be remembered that every time the camera is moved there is a fresh scene. This makes a comparatively large number of scenes in a long play, such as a five-reel drama, unavoidable and vitally necessary, as the eyes of the audience cannot remain for long fixed on the screen without the momentary rest produced by a change of scene, but it also makes a scenario very scrappy reading. There are seldom any sub-plots in a screen-play. There may be unexpected developments of the main story but no wandering from the theme, as is so often the case in novels. The scenario of a screen-play reads something like the following—

SCENE III

Interior of Study

Allan Rivers walks in—crosses room to bureau—takes out bundle of letters—glances at them—hesitates as if troubled by conscience—places them resolutely in breast pocket—looks round cautiously—exits nonchalantly.

In the writing of a screen-play the limitations of the camera are taken carefully into consideration, together with the "style" of the principal actor, actress, or film company. The scenery required for the outdoor

locations must also be thought out with due regard to convenience and possibility. It would be manifestly absurd to expect a London company to find in one scene a tropical beach with native canoes gliding up palm-coves and a few scenes later an Alaskan pine-forest in mid-winter. Yet these two scenes would not be difficult for a Californian producer, with a semi-tropical seashore and a range of lofty pine-clad mountains, snow-covered in winter, within a day's journey of the studio.

Many of the large producing companies employ a staff of playwrights, but so rapid is the rate of film-production that even these look for outside contributions to obtain new ideas and plots.

A scenario editor in the course of a year wades through a sea of novels, manuscripts, ideas, plots, and fully-fledged scenarios, in order to obtain from the mass of material presented from twelve to twenty-four themes capable and worthy of being produced by his company. He keeps the characteristics of the principal "Leads" employed by his firm strictly in mind, and when something, possibly only the germ of an idea, has been found it is acquired, and he sets to work to elaborate it into a full scenario.

In order to do this he must study the type of characters, the period, dress, place, time and atmosphere, so that by a few deft touches he can convey, during the ordinary working out of the plot, the requisite appearance of heat, cold, wealth, disguised poverty, criminal instinct, inherent truth, honesty, innocence, or some other condition, emotion, virtue or vice. Not by dialogue, but by the small actions of his characters. It is this governing factor—that by actions alone can character be portrayed on the screen—which makes the work of the scenario writer and editor so difficult.

When this has been done and the play is complete,

it is divided up into "actors' parts," "scene-plots," "lighting-plots," "locations," "camera-plots," and other detailed sets of instructions for the guidance of the different departments concerned in the production. The art-director gets busy with the designs for the scenery, the furniture, the setting of the scenes, the dresses, and the general artistic effects. The location-man journeys forth to survey chosen areas of country for the outdoor scenes. The electrician commences work on the lighting-plot for the studio, and may possibly have to prepare a portable light for some out-door scene. The cinematographers view the rehearsals and decide the exact positions for their cameras to be placed in order to take each scene from the best point of view, bearing in mind the time of day and consequent position of the sun for out-door locations. The carpenters erect the necessary scenery, which has been prepared by the scenic artists. Supers are engaged for "crowd work." The scenes are set. Furniture is moved into position; and all is ready for the actual taking of the picture.

While this has been going on the director has been carefully coaching and rehearsing the actors. It may happen that the last or middle scene of the play is actually taken first. There are various reasons for this. It may be a question of time of day or year, the loan of some particular garden, house, or public building, ordinary convenience, or one of a hundred contingencies which makes it easier, advisable, or time-saving. Then comes a wait for suitable weather for some outdoor location, or possibly a long motor journey to a suitable spot, followed by a night in sheds for the whole company.

In warm countries, such as California, an early start is usually made, perhaps at four or five in the morning,

and the work is all over before mid-day, when the sun is hot and almost directly overhead. It is no unusual thing for the scenes of two or even three plays to be taken in between each other, and for the whole company to be transported many hundreds of miles for the purpose of taking two or three scenes which are afterwards used in different plays. Many of the Californian companies have travelled several times up and down the thousands of miles of coast-line to the snows of Alaska. London castes have been taken to Italy, South of France, Algeria, the United States, Canada, Belgium, and Egypt.

It frequently happens that a scene which has taken weeks to prepare or is situated several days' journey from the studio, is actually filmed in a few minutes. For certain out-door effects the permission of some local authority, the police, or a private individual, has first to be obtained, and this forms yet another of the diverse duties of the location man.

The actual taking of each scene by the camera is a question of photography, and calls for the exercise of considerable knowledge and skill on the part of the operator. Many hundreds of feet of negative film are frequently spoiled, and scenes often have to be re-acted two or even more times before a perfect negative is obtained.

When all the scenes have been filmed with the necessary *re-takes*, the whole mass of, perhaps, 10,000 to 15,000 ft. of negative is passed through the developing and printing-rooms, and is handed over to the film editor, who cuts, arranges, transposes, deletes, and finally re-assembles into the continuity of a complete screen-play, ready for release to the thousands of electric theatres.

It may appear a comparatively easy task to join up

the different scenes and so make the complete film-story, and it would be if this was all that a film editor had to do. In order to gauge the difficulties of this branch of the industry, however, it is necessary to first understand the condition of the material sent to the editorial, or cutting and titling department. So interwoven are the functions of the editor, or cutter, and the title editor that the two must work in perfect harmony in order to produce good pictures.

It is true that the first requisite of a screen-play is a good written scenario, but owing to the necessity of focusing so many minds on the production of the story in pictures the finished article can never be absolutely identical with the author's conception. When each action of a play has been photographed, a slate is held up before the camera upon which is written the scene number and certain signs informing the developing and printing staff of the light conditions at the time of taking, and giving any other information affecting the developing and printing of the film. The number and signs are then photographed and serve to identify the action with the scenes in the written continuity or scenario.

These numbered actions may be in any order, owing (1) to the custom of taking scenes without reference to their true sequence, and (2) to the re-taking of certain parts. Thus, there may be a hundred or more different scenes in chaotic order, with a number of retakes, all of which are identifiable only by the number marked at the end of each.

This mass of film lengths, amounting to perhaps 15,000 ft., or three miles of celluloid ribbon, when developed and printed, is taken to the editorial or cutting-room. The whole is then projected on to the screen, and cutting commences, for one scene may

have been acted four or five times over, and the editor must select the best action and cut out the remainder. In order to get a good scene it is, however, very often necessary to take a few feet of film from each of the re-takes and paste the sections together in their proper sequence. A very difficult and trying operation.

When this has been done the length of film may have been reduced to 6,000 ft., and every scene is then carefully scrutinized in order to discover if any of them can be improved by shortening, what episodes, not essential to the story, can be left out, and finally, if the film-length still exceeds the 4,000 to 5,000 ft. which is most popular, what part can be cut and its action covered by a short descriptive title.

One of the many differences between stage and screen plays is that in the case of the former the action is accompanied by the spoken word, and the interest of the audience is divided between eye and ear, so that one scene may run continuously for as long as thirty minutes. Tests have proved conclusively that in the case of the screen the human eye tires after about three or four minutes, which compels a change of scene in, at least, every 150 to 200 ft. of film. When an action runs over this length it must be broken either by titles or by *collateral* scenes (i.e. those which carry on the collateral action).

There is, in addition to all this more or less straightforward editorial work, a large number of what are known as " psychological cuts." No actor can compete on the screen with a baby (or animal pet) and command the attention necessary for the continuance of the story. The entire attention of the audience would be focused on the infant, and any movement by the actor, however important to the story, would be lost. A situation

such as this necessitates the film being cut and "close-ups" introduced; first of the baby and then of the actor, thus registering the essential action of the latter without the diversion of the former.

Many other similar psychological problems have to be faced and overcome by the cutter in conjunction with the title editor, for when cutting cannot be done a title must be resorted to.

In order to realize the amazing work of the film editor in a big studio it is necessary to visit the cutting-room and see for oneself the miles of film lying on the shelves in spools, filling baskets, coiling and twisting on tables and desks, all in apparent inextricable confusion. Then, with the aid of a magnifying glass, just try to find a given little picture in a roll of film. It will probably take hours, whereas an expert cutter can pull the celluloid off the spools with wonderful rapidity and stop suddenly on the exact little picture required.

Before leaving the subject of fiction film making something must be said regarding the punctuation of screen-plays. It will be obvious that where pictures are used instead of words to convey a story to the human brain, the comma, semi-colon, and full-stop cannot be used. In their place there are, what are technically known as the "close-up," the "iris," and the "fade-out." These forms of pictorial punctuation cannot be used, however, in the lavish and often reckless manner of the literary punctuation marks. They are far more emphatic and must therefore be used sparingly.

The "close-up," as its name implies, is the enlarging of one small but important portion of an animated picture at the expense of the background, or, in simpler vein, the focusing of the camera so that a face or object is made to appear, when thrown on to the screen, quite *close-up* to the audience. In this way the beauty and

innocence of the heroine, the cunning expression of the villain, the determined features of a leader of men, are *emphasized* without words or literary signs. By this means also attention is focused on the "stars," and interest aroused by the close view afforded of their faces, which usually form an index to the parts they are destined to take in the play. Physiognomy and psychology are well-known sciences to the efficient director.

The "iris," which is named after the iris-shutter of the camera, causes the picture on the screen to gradually contract in a circle from the outer edges, the focal point getting smaller and smaller until it rests on the face of the heroine, the spire and cross of a church, the broken safe from which documents have been stolen, or some other point in a picture upon which it is desired to momentarily focus the entire attention of the audience. It takes the place of *italics*, and may occasionally be used to impart an atmosphere, as, for instance, when, in the small circle of light in the centre of the screen, only a church spire is visible, then a bell chimes, the circle grows larger, the church is seen, still the circle increases and the whole view becomes visible with a peaceful village street, the people wending their way towards the House of God. It is Sunday morning.

The "fade-out" is the full-stop of the screen-play. As its name implies, it is the gradual fading out of the picture, which is mentally suggestive that the action is finished, and therefore is very frequently used when the play is over, like the drop curtain in a theatre. It has, however, other uses even more important in screen-technique than an artistic finish. It is employed to give the mental impression of a lapse of time. By *fading-out* on one scene, such as the hero stepping across the gangway of a liner lying alongside the docks at Liverpool,

and then *fading-in* with a view of the Statue of Liberty from the deck of the ship, the voyage across the Atlantic is accounted for. Similarly by fading-out on a log cabin amid the snows and fading-in on the same cabin bathed in sunlight and surrounded by foliage, the passing of a season is mentally suggested without the use of words.

CHAPTER VIII

TRAVEL, TOPICAL, AND SCIENTIFIC FILMS

In addition to the wonderful pictorial records of the expeditions led by Scott, Shackleton, and other daring explorers there are films of travel and adventure in many lands, curious customs of living races, little-known industries, moments in the natural lives of birds and beasts, and episodes which include the taking of motion pictures beneath the waves, above the clouds, and in the craters of volcanoes.

It has been said that many travel films are so dull and uninteresting that exhibitors and the public generally have fought shy of them. The reasons for this are not difficult to understand. The essential difference between an optical lantern slide and a cinematograph film is that whereas the former presents a still view the latter is animated. If, however, the object depicted is a mountain, a vast stretch of beautiful country, an iceberg, a castle, or other motionless object, it matters not whether it is photographed by an ordinary camera or by one of the cinematograph variety, the result, when thrown on the screen, will be a still view. It is true that in one case the picture will be steady and free from flicker and in the other it will have a certain amount of *false* movement.

For this primary reason travel subjects need to be very carefully chosen before they are filmed. It is not sufficient to impart animation to an essentially still view by photographing the movements of a guide conducting a party of tourists over an old chateau, or filming an Alpine guide leaving the valley and then to

show the peak which he climbed. In both cases the *main objective* is essentially a still view, and could be covered by a lantern slide.

To introduce sufficient movement into a picture of tranquil beauty or grandeur as to warrant its being taken with a cinematograph camera for subsequent public exhibition, it is necessary to organize a scene or act which must have a definite purpose, making use of the natural background in the same way as a stage setting. This is what actually happens in the case of an expedition into the unknown. Animation is lent quite naturally to what would otherwise be a series of still views by the exploring parties, sledges, dogs, reindeer, hunters, carriers, esquimaux, indians, negroes, cannibals, camps, wild beasts, birds of prey, curious native customs and modes of life and warfare—all legitimate subjects for the film. At the same time that great compelling force, curiosity, is aroused in an audience by the element of mystery which surrounds the semi-explored and unknown lands. The whole series of pictures have a continuity or purpose in the object of the expedition.

The same considerations apply to a well thought out travel film which cannot be called the record of an expedition. It must portray the actual life of the people of one land to those in another, and it must be *life*, bare, brutal, pulsating, domestic, industrial, nomadic, or warlike, with the scenery beautiful, grand or monotonous, as the natural environment, and the object of the journey clearly stated and of sufficient importance to form a continuity. If it is Mont Blanc that is to be conquered it is better to state the object, show all the difficulties and dangers of the actual ascent, and fail on the Grand Mulets in a blizzard, than to reach the summit without showing in detail how the

climb was accomplished and the magnitude of the final triumph. If it is a land of curious native tribes which is to be entered, then the people and their mode of life will be of more interest to an average audience than the land in which they live, though this forms the natural scenery for the story. If it is a great engineering feat, such as the Panama Canal, then the Canal as an accomplished fact will be of less interest, from the motion-picture point of view, than the means adopted and which brought success combined with an adequate but not elongated presentation of the great benefit bestowed.

There is one great economic advantage which a really good travel picture possesses over a fiction film, it is as intelligible and interesting to the people of one country as it is to those of another, and its scope is therefore not limited by the literary likes and dislikes of different nationalities. It has, however, to be a very first-class product to command the same market value as an exclusive drama or comedy by one of the well-known star companies.

Among the many really interesting travel films of recent years, leaving out the world-famous records of Arctic and Antarctic exploration, and the historic war films, may be mentioned the picturized voyages of Mr. and Mrs. Martin Johnson among the cannibals of the South Sea Islands, which gave to the world what, in all probability, will be the very last glimpse of a native race and its terrible customs fast passing into the realm of history. In the neighbourhood of the Bahama Islands some remarkable films were taken beneath the surface of the sea of submarine flora and of a fight between a negro and a man-eating shark. Good views were obtained up to a depth of 60 ft. by means of a tube lowered from a boat. At the bottom of the tube

was a chamber accommodating the operator and the camera. The actual photography being accomplished through a glass panel in the side of the chamber, and by the aid of exterior artificial lighting ; 2,400 candle power Hewitt quartz-tubes being used.

Among other interesting episodes with the cinematograph camera may be mentioned the descent of Mr. F. Burlingham, who had previously conquered both Mont Blanc and the Matterhorn for the film, into the crater of *Vesuvius*, when a wonderful series of pictures were obtained of the sea of smoking lava in the heart of the volcano at a depth of 1,200 ft.[1] The filming by an Austrian engineer of the crater of *Stromboli*. The ride of a cinematographer on the cow-catcher of a locomotive through the Canadian Rockies in winter. The Cherry Kearton studies of wild animals. Many wonderful films taken from aeroplanes, and really exciting scenes of Alpine adventure.

The taking of a good and artistic travel film requires a sound knowledge of what is and what is not of general public interest, combined with considerable experience of cinematography. Contrary to the belief expressed by many amateurs, field operating, as outdoor cinematography is called, requires quite as much knowledge of the tricks and limitations of the camera as studio work, because the all important factor of light cannot be controlled at will, and it is usually the unforeseen which occurs directly a commencement is made. Outdoor cinematography is a separate study and is far too complicated to be even briefly touched upon here. There are, however, various mechanical helps, such as the Watkins Kinematograph Exposure Meter, which tests the actinic value of the light, making the allowances necessary for different countries and altitudes. This

[1] Granger's *Marvels of the Universe*

wonderful little instrument was successfully used by the well-known cinematographer, Mr. Ponting, both in India and during Captain Scott's Antarctic Expedition.

In moving picture work the camera handle is usually revolved at a uniform speed (120 to the minute) and as the aperture of the revolving sector shutter usually remains unaltered (although the best cine-cameras have an adjustment for altering this) the convenient way of attaining correct exposure is to test the light with a meter, and *vary the aperture of the lens* in accordance with the test. It has been found best to devise a special meter for this, in which the diaphragm values read against the shutter speeds. The use of a meter is most important in such work in order to get different parts of a long film (exposed, perhaps, in different lights) to approximately the same density for printing.[1]

It is interesting to note here, in relation to trick films, that turning the camera handle too slowly causes the movement of objects photographed, when shown on the screen, to appear too rapid, and if the handle is turned quickly the picture when exhibited will have a slow movement.

Topical Films. About these films little need be said here, for they will be familiar to every picture-goer, and they adequately explain themselves. They are pictorial records of the important topical events taking place in all parts of the world. Among the principal screen newspapers should be mentioned, the *Pathé Gazette*, the *Pathé Weekly Pictorial*, the *Topical Budget*, and the *Gaumont Graphic*.

In order to show the class of news-pictures given in each weekly and bi-weekly edition it may not be out of place to give here the "List of Contents" of the London editions of three of the principal publications for that epoch-making period in 1919, which brought the Great European War to a fitting close.

[1] Extract from *The Watkins Manual*.

Pathé Gazette, No. 577.—*Released Thursday, 3rd July.*—PEACE DAY: Huge crowds throng Trafalgar Square at 3 p.m. Mrs. Lloyd George announces "Peace is signed." Thousands flock to acclaim the King at Buckingham Palace. The King and Queen and Royal Family appear. The King meets and drives back with Mr. Lloyd George, who brought us "Peace with Honour."—THE HISTORIC SCENE AT VERSAILLES: The German delegates arrive and are conducted to the Hall of Mirrors. The Big Four are seen to the left of the picture. The signing. The Prime Minister and Mrs. Lloyd George home again at Downing Street.

Pathé Gazette, No. 578.—*Released Monday, 7th July.*—ANOTHER AIR TRIUMPH FOR BRITAIN: The R 34—the first Transatlantic Air Liner. (Approved for publication by the Air Ministry.)—SIXTEEN AMERICAN OFFICERS decorated by Sir Douglas Haig on the Horse Guards Parade.—THE PROCLAIMING OF PEACE: the old-world ceremony at Temple Bar. A fanfare announces arrival of Bluemantle, who demands "admission" to the City. The City Marshal conducts Bluemantle to the Lord Mayor, who gives permission for the cavalcade to enter. Reading the Proclamation at the Royal Exchange.—CHILLY HENLEY: Bad weather mars opening day's racing.—SCUTTLED: All that is now visible of the once proud German "High Seas" Fleet at Scapa Flow.

Pathé Weekly Pictorial, No. 66.—*Released 7th July.*—AN AEROPLANE STARTER: A wonderful French device for starting aeroplane engines which will obviate many fatal accidents is shown.—BAMBOO AND ITS USES: An interesting film showing how this universally used material is grown, cut, transported and used.—RATS: The menace of the rat—the carrier of many frightful plagues—is clearly explained, and several methods of dealing with these pests are shown.—THE UPPER REACHES OF THE THAMES: A charming coloured film illustrative of some delightful spots, merry picnics and shady nooks on England's greatest river. (Pathécolor.)

There are, of course, editions and separate publications in the principal capitals of the world, and the interchange of topical films between one country and another forms the special feature of all screen-newspapers. The rapidity with which the world's events are translated into moving pictures is certainly remarkable, but this does not mean that every cinema theatre is able to show the most up-to-date happenings. The time of exhibition

depends upon two primary factors ; (1) the country in which the event occurred compared with the distance and means of transport to the distributing centre for the theatre in question ; and (2) the price the theatre is prepared to pay for its animated newspaper. There is a graduated series of charges for each edition or number ; the price of hire decreasing each fourth day after the edition is released for exhibition. Certain theatres pay the higher price in order to show the pictures first, others wait a few days and obtain the reduction.

The short topical pictures included in each edition of these screen-newspapers are obtained by a staff of cinematographers in the principal cities of the world and by contributions from outside sources. The editing, printing and distributing is usually carried on in the capital of each important country or area. It is estimated that the English edition of the *Pathé Gazette* is seen by seven millions of people every week.

There are, in addition to the animated news-pictorials, several different forms of screen-magazines, such as that issued by the *Trans-Atlantic* Company, in which *interest* films are the predominant feature. By interest films is meant a variety of subjects which cannot be classified under such recognized headings as fiction, travel, or topical. They include wonderful inventions, little known industries, applied art, feats of engineering, and other events capable of effective illustration. When carefully chosen and well photographed they are certainly very interesting to the average person who desires to know something of what is being accomplished in different parts of the world.

These travel, topical, and interest films tend to raise the level of moving pictures from the purely recreative, albeit artistic sphere, to the semi-educational. But, to

refer to them publicly as "educational" is to do them a disservice, for there are many who object to being lectured out of school. The reason for this has hitherto been that education in whatever form disguised was usually "made-to-measure" by a pedagogue whose chief qualification appeared to be that he knew better than most how to make a subject so thoroughly dry and uninteresting that the average human brain positively revolted from its proper duty of mastication. Whereas almost everything we see, even when at play, is adding to our stock of common knowledge, and almost every educational subject is capable of such lively description and such interesting methods of exposition, as, for example, by the use of films, lantern slides, lectures, etc., that its digestion becomes both healthy and pleasurable.

Scientific Films. This class of cinematography may be roughly divided into two sections: (1) that which *is* scientific; and (2) the mere filming of scientific subjects. The principal branches of the former are, *colour-cinematography*, which is the filming and subsequent projection on to the screen of pictures in natural colours—not obtained by tinting or artificial colouring; *cinestereoscopy*, which is the application of stereoscopic principles to cinematography in order to obtain an appearance of solidity (relief) for objects thrown on to the screen; *cinemicrography*, or the filming of microscopic movement in plant and animal life, etc., with the aid of a cinematograph camera and a microscope; and *talking animated pictures*, which aims at the addition of human voices and spoken-words to what is at present dumb-show.

Very elaborate apparatus is at present required for all these different classes of work, and scientific cinematography is quite beyond the scope of this short treatise.

The filming of scientific subjects is little more than ordinary cinematography, although much ingenuity is often necessary in order to obtain good results. An example of this class of work which will probably be familiar to most readers is the illustration on the screen of a plant growing at a remarkable rate. A variation in the taking speed of a cinematograph camera gives the effect on the screen of a shortening or lengthening of the natural period of time. In order to show the growth of a plant a camera is fitted with a gearing-down device, so that, instead of 60 ft. of film being exposed in a minute a whole week elapses before this amount of negative has passed the lens aperture. The result, when projected on to the screen, shows a reversal of the order, and depicts in about a minute the actual growth of the plant in a week.

There is often a distinct connection between so-called popular scientific films and trick cinematography, although for making theoretic lectures practical there can scarcely be a better method devised than the cinematograph film. It has already been used in almost every branch of science, industry, commerce, and warfare.

CHAPTER IX

FILM DISTRIBUTION AND PUBLICITY

When a negative film has been made with the aid of a cinematograph camera and positive copies printed from it, the resulting film—providing the subject is of sufficient public interest—becomes a copyright and marketable commodity. Although in some cases the producer and proprietor of films prints all the necessary copies himself, employs travellers, advertises, and lets his films out on hire direct to the cinema halls, the more usual method is for the actual work of distribution to be carried on by speculative buying agencies, known as "renters." These are the "middle-men" of the film industry. They buy or rent from the producing studios and let them out to the exhibitors, doing all the work incidental to a great selling and distributing agency.

When a positive film has been printed, titled, tinted, and toned, and is, from the producer's point of view, a completed article, it is usually thrown on the screen in the studio for what is known as a "private view." All the departmental heads responsible for the production and the principal actors and actresses, are present, and form a body of expert critics. In this way minor defects are remedied before the film is shown in public. This takes place at what is called a "Trade Show," usually held in the private electric theatre in the head offices of the producing firm.

At this important exhibition, film reviewers, viewers, buyers, renters, large exhibitors, and others *financially*

and commercially interested in the industry are present in numbers varying with the importance of the film as a "pay-box attraction." It has now passed out of the producing stage and has begun its *life* as an earner of royalties.

A film may have been sold outright by private treaty or arrangement before the trade show, or more likely during or after this first semi-public exhibition. On the other hand, it may be issued by the producers as an "exclusive" or "open market" film. One or other of these latter methods is most usual.

The producer or owner of the copyright of an exclusive film generally offers for sale what is called the "territorial rights." By this is meant the exclusive right to exhibit the film in a defined county or area. These guaranteed territorial rights are *bought* by English provincial, Scottish, Irish, and Foreign *renters*, who then give trade shows in their own "preserves" at which local exhibitors are present, and they send around travellers to the cinema theatres, issue posters, advertise, and generally do their best to "boom" the film in their own area. The local exhibitors *hire* the film from the renters also with the *exclusive* right to show the picture in their respective towns, or at least under a guarantee that the same film will not be shown at a competing cinema within a certain local area before or during the exhibition at their own theatre.

In the case of an *open market* film the copies are offered, with only one restriction, to anyone who cares to buy them, either for the purpose of exhibition in one or more theatres of their own, or, to renters, for letting out on hire to local cinema proprietors. The single restriction being that the film shall not be publicly exhibited before a given *release date*. This system of distribution causes the actual day of release and the two succeeding days

to be the most valuable in the life of each copy of the film, and is called its *first-run*. A higher rental is charged for this period than for each succeeding three days, which are called the second, third, fourth, fifth, and sixth run ; and the price decreases every fourth day when the majority of cinematograph theatres change their programmes.

The life of an open-market film seldom exceeds a few months after which it becomes "junk," and is sold at a very cheap rate to second-hand film dealers who ship their wares to remote foreign countries.

The way in which a film is marketed greatly depends upon the value of the subject as a pay-box attraction. A good play, whether drama or comedy, featuring one or other of the well-known stars of the screen, will, more often than not, be issued as an exclusive, although many of the large American producers now favour the open-market system. Only in the case of some unique experience or feat of exploration, which has been widely commented upon in the newspapers, does a travel film warrant release as an exclusive, although its value may be far more abiding than a play. An interest film is always an open market release, and topicals, if of more than local interest, are usually sold outright to one or other of the film gazettes.

Regarding the market value of films it is quite impossible to give any figures here. Some big American productions have brought their owners millions of dollars, others have earned but little more than they cost to produce. Considered generally, however, if a film is a good one a profitable market will easily be found, if it is a *very* good one, its value may equal that of a gold mine.

Before being released for public exhibition in the United Kingdom, all films, except topical subjects,

are voluntarily submitted by the producers, importers, or renters, to the British Board of Film Censors, London, which is, however, not a Government Department, but an independent body with such wide powers that it is now looked upon as a national institution. The Board undertakes the examination of any film for a small fee, and if satisfied that it contains nothing of an injurious character it grants a certificate which *must* be thrown on the screen. Both producers and exhibitors enter into a firm agreement not to publish or exhibit anything which is objected to by the Board, and many local licensing authorities make this a condition when granting a license to an electric theatre.

Cinematograph films, when placed for distribution on the English railways, must be encased in special boxes made to the specification of the Railway Clearing House. These boxes must be made of galvanized iron, lined with wood, and locked and labelled in a special way. Over a million of these film-boxes are carried by the English railways every year.

Almost everyone will have noticed the enormous amount of publicity obtained by film stars and by producers for their films. In addition to the natural advertisement secured by the projection of artistes' names on the thousands of screens, there is a fourfold combination of publicity experts engaged in making known the attractions, charms, and artistic merits of both actors and films. In the first place there is the publicity agent who loses no opportunity of bringing the name of his employer before the public in the form of paragraphs in the daily and weekly journals, interviews, and photographs ; next comes the publicity manager of the studio producing the films, who takes advantage of the fame acquired by the artiste to couple it with the particular film in which he or she is appearing

at the moment, by the aid of posters, attractive illustrated booklets, newspaper reports, and clippings of the actual film enlarged into striking photographs for exhibition outside the cinema halls ; then, when the film is released and exhibited at trade shows, representatives of the general as well as the cinematograph press are invited to attend, and a further flood of newspaper criticism is obtained. Next come paid-for advertisements in all the trade journals and in certain dailies and weeklies, and finally, when the film is exhibited in the cinema halls it is again advertised by posters, and by reviews and advertisements in the local press.

It is but natural that all this concerted effort to obtain the requisite publicity should result in the creation of wide public interest in films and film favourites, especially when it is remembered that cinema halls provide amusement for millions of people every night of every week in the year, and that certain actors and actresses become, by repeated appearances in different *rôles* so familiar to regular picture-goers that the post-bags of these artistes are filled with letters from admirers living in different parts of the world.

This widespread public interest has brought into being new journalistic productions, which are neither trade papers nor technical journals, but just popular screen reviews, often elaborately illustrated and enjoying extensive circulations. In England these are represented by such publications as *The Picture Show*, *Pictures and Picture Goer*, *Cinema Chat*, *Picture Plays*, etc. ; and in the United States by even larger publications. These weekly reviews are in addition to such old-established trade journals as *The Kinematograph and Lantern Weekly* and the *Cinema*.

Even the great dailies and weeklies, with the serious

affairs of a troubled world to record within their strictly limited space, have felt the pressure of public interest and devote columns to the description of plays and players for the silver screen.

All this is proof, if such is now necessary, of the part the cinema has come to play in the everyday life of nations.

CHAPTER X

THE PROJECTOR AND THE SCREEN

So far we have dealt mainly with the different phases of film-production and distribution, reserving for the present and succeeding chapters the equally as important exhibiting side of this new and rapidly developing industry. These two branches may be looked upon as the wholesale and retail of the cinematograph industry, which, as a whole, is, however, much more akin to applied art than to either trade or commerce ; embracing, in the first, or productive stage, the combined work of authors, artists, actors, and photographers, and in the latter, or exhibiting stage, the acumen of the film-buyer and renter combined with the commercial, as well as, in a minor degree, the artistic attributes of the local exhibitor.

In exactly the same way as the camera forms the chief apparatus employed in the production of cinematograph films so is the *projector* the primary appliance used for their exhibition. In fact it was the invention and ultimate perfection of these two optical and mechanical devices which made moving pictures possible ; all else is auxiliary to, and has grown up around, these two revolutionizing inventions. The former has already been dealt with, and it is the purpose of this chapter to describe the essential features of the somewhat complicated little pieces of mechanism known to the trade as "Projectors" and to the man in the street as cinematographs.

Although there are a large number of different types

of projectors in use at the present time in the 87,000 electric theatres of the civilized world, each of which has its own peculiarity, a general survey of the essential features common to nearly all types of machines will enable even the non-technical reader to quickly grasp, at a subsequent period, the salient points of any particular design.

At the risk of being considered absurdly elementary it must be stated that the object of a projector is to project, and simultaneously enlarge, the tiny photographs upon the transparent celluloid film, on to a screen by the aid of lenses and a powerful light in exactly the same way that slides are exhibited by an ordinary optical lantern. The essential difference between the modern instrument used for motion pictures and the older apparatus used for still views is that the former must create the illusion of natural movement by projecting the pictures on to the screen in very rapid succession.

In order to accomplish this the film is drawn past the back of the *objective* lens by a mechanical device which imparts an *intermittent* motion. Each little picture remains stationary between the lens and the light for one-sixteenth of a second, and is then replaced by the next picture. This movement is merely a reproduction of that which took place in the cinematograph camera when the pictures were actually being taken. Thus, when we are looking at a moving picture in a cinema hall what we really see is sixteen different pictures thrown on the screen every second, but owing to what is known as *persistence of vision*, combined with a mechanical device called a rotary shutter, which is fitted to every projector, and serves to momentarily cut off the light from the screen during each change of picture—i.e. sixteen times a second—instead of being

able to observe each distinct view the pictures blend and the illusion of motion is created.

All of this is made possible by two factors, one of which is the transparency of the film, which allows light from the electric arcs in the back of the projector to show through the celluloid, in the same way as it does through the glass of a magic lantern slide, and so throw the shadow image, made by the film-photograph, on to the screen with the aid of the *objective* lens.

In order to concentrate as much light as possible on to the tiny picture as it rests momentarily behind the objective, or focusing lens, another combination of lenses, known as "the condenser" is introduced between the arc-lights and the film. These catch the divergent rays of the powerful electric flame and concentrate them, like the beams of a searchlight, on the small aperture called the *gate*, past which the film is being fed by means of the *escapement*.

Here it is advisable to pause for a moment to consider what has been accomplished. The film, bearing its minute photographs, is being passed between two lenses, one concentrates the light from electric arcs in a steady beam through a small aperture, in front of which the film is passing, and the other focuses the pictures on the screen which must be situated at a fixed distance from the projector. The film is being passed through, or *fed*, in a series of intermittent movements which allows sixteen little pictures to rest momentarily between the lenses every second. When one picture is replaced by the next the light, passing from the arcs, through the concentrating lens, film, and focusing lens, out in to the cinema hall and on to the screen, is momentarily cut off by a rotary shutter. This causes the "flicker" which is ever present in a major or minor degree when motion pictures are being shown.

This completes the optical side of projection and brings us to the purely mechanical means by which (1) the film is intermittently moved past the gate; (2) the rotary shutter is made to cut off the light at the psychological moment—sixteen times a second—when each little picture is being substituted for the next on the thousands of feet of film, and (3) the very powerful and continuous light is obtained.

The intermittent movement of the film past the gate, or light aperture, is caused by what is known as the *escapement.* There are several different devices which encompass this object, and they are called *claw, maltese cross,* and *dog* escapements. In each case the film is moved forward about three-quarters of an inch (one picture) every sixteenth of a second by "claws," or teeth, engaging in the perforations on each side of the celluloid. This is usually accomplished by an eccentric wheel.

The rotary shutter is, in principle, a very complicated affair, although in actual practice it is quite simple. It consists of a three-bladed wheel revolving in front of the objective, or focusing lens (see Fig. 24). One blade is larger than the other two, which are known as dummies, and it is while this large blade is obscuring the light coming through the lens that each little film-picture is substituted for its successor. The dummy blades merely increase the number of dark intervals, and so make each one less observable to the human eye. Without these dummies the single dark interval, during which the picture is being changed, would be too pronounced, but, by multiplying their number they become too fast for the human eye and brain to properly register.

Although the powerful light necessary for motion picture projection can be obtained in a variety of ways, such as by electricity, limelight, and oxy-acetylene,

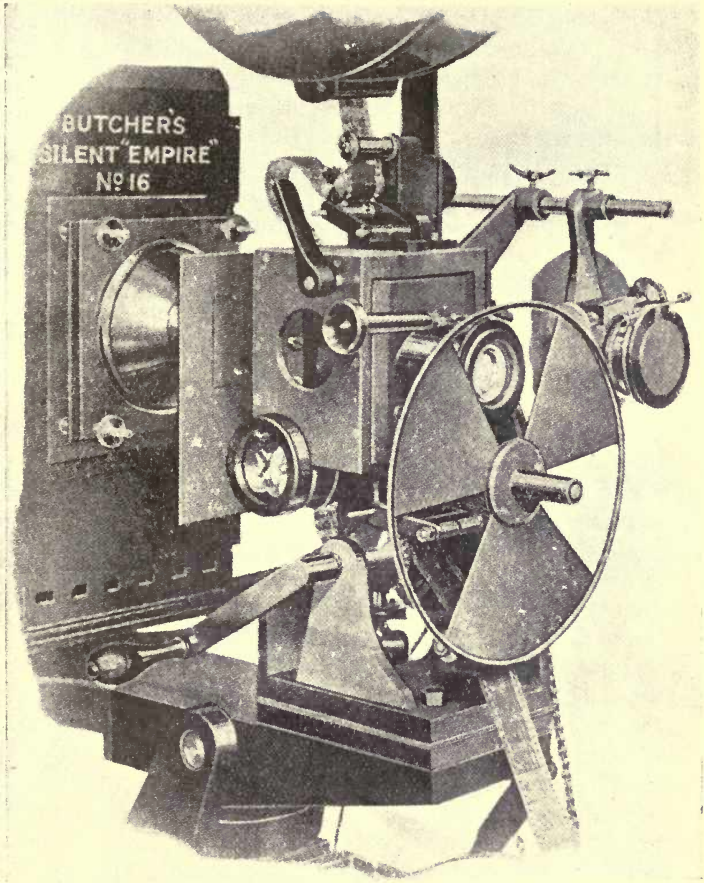


FIG. 24

BUTCHER'S "SILENT EMPIRE" PROJECTOR, SHOWING MECHANISM AND ROTARY SHUTTER

the means employed in almost every theatre of importance, except those far removed from civilization, is the electric-arc, by means of which it is quite easy to obtain from four to five thousand candle-power from a flame barely half an inch in length. The intensity of the light is, furthermore, directed and concentrated by means of reflectors and the condenser lenses of the projectors.

About arc-lamps little need be said here, because of their undoubted familiarity to every reader. The system employed is to interpose two carbon pencils in an electric current, then, when the current is turned on, to "strike" the carbon points by allowing them to touch each other, and afterwards to move them slowly apart. The flame occurs between the pencil points, and as the carbon burns away in the intense heat the pencils are kept about a quarter to half an inch apart by controls (see Fig. 25).

It is quite beyond the scope of this little work to enter into lengthy descriptions of the different electric lighting systems, upon which there are many good text-books. Questions of supply—*direct* or *alternating*—play an important part, and many electric theatres are now equipped with engines, dynamos, transformers, and other complicated electrical apparatus for making their own current. In such cases they are quite independent of town electrical systems.

The size of a picture on the screen and its clearness are more or less determined by the power of the illuminant in the projector, and the correct centring of the beam of light on the screen by the operator. There are, however, certain marks that frequently appear on moving pictures, known as *gate* or *electrical* markings, which have nothing to do with the lighting, being blemishes on the film itself.

The essential features of a projector having now been

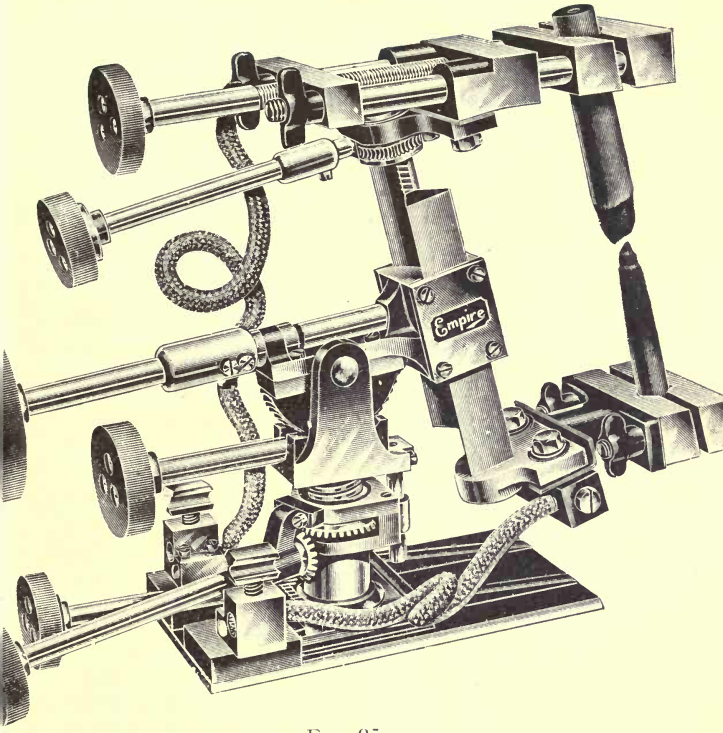


FIG. 25

"EMPIRE" ARC LAMP WHICH FITS INSIDE LAMP-HOUSE OF PROJECTOR

described, there remains only to show ; (1) what motive power, and by what means, all this mechanism is operated simultaneously, and (2) how the different devices are assembled into a complete instrument.

The old method of turning the mechanism by hand has long since given place to a power-driven projector in all places where electric current is available. The hand-drive is still used, however, as a stand-by in case of sudden breakdown. A small electric motor of from one-sixteenth to one-eighth horse-power is usually employed. It is controlled by a regulator, preferably of the sliding-contact type, giving considerable variation of speed. The driving-wheel of the motor is connected by a chain or belt to the pulley of the projector. The mechanism connecting the pulley with the intermittent movement, the rotary shutter, and the re-winding gear on the lower film-spool, is of quite simple design and consists of spindles and gears.

The assembly of these essential devices into a complete instrument, with the addition of various refinements, is entirely a matter of individual design. In the making of projectors accuracy of workmanship, producing smooth running, is the primary factor ; and there are many types, of both English and foreign manufacture, which fulfil all reasonable requirements.

In Fig. 26 will be seen a Williamson " Silent Empire," which consists of a single pillar pedestal stand with tilting head, on which is mounted the mechanism. This head can be moved over a wide angle and locked steady when the beam of light is accurately directed on to the screen. The stand also carries the take-up spool, which is provided with a chain-drive from the motor fitted on a bracket half-way up the pedestal. The supply-spool is supported by the mechanism of the projector itself, which is fitted on to the tilting

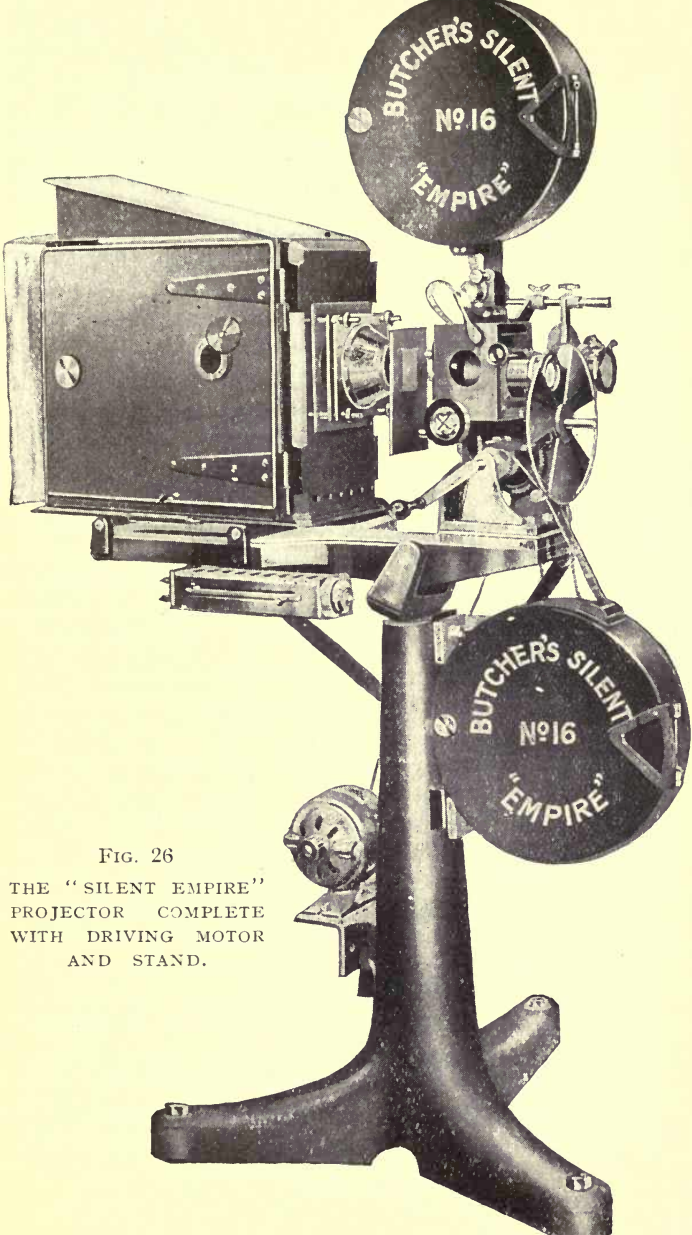


FIG. 26

THE "SILENT EMPIRE" PROJECTOR COMPLETE WITH DRIVING MOTOR AND STAND.

head. The lamp-house, forming the back of the instrument, encloses the arc-lamp (Fig. 25), and is scientifically ventilated. It has a sight-hole in the side door for observing the adjustment of the carbons, and is provided with an asbestos back-curtain. The light-funnel with the condenser lens projects from the front of the lamp-house towards the gate mechanism. Here is the maltese cross intermittent movement, which runs in an oil bath, with a glass port-hole for inspection. Beneath this is an automatic safety-shutter, controlled by a pair of heavy governors. It is extremely sensitive and responds instantly the machine is started or stopped. Next comes the objective or focusing lens with the rotary shutter operating in front of it. The path taken by the film will be clearly seen in Fig. 24.

For showing ordinary optical lantern slides there is a flange for the objective lens fitted to the left side of the mechanism, with adjustable centring. The lamp-house being moved over on transverse rails.

The number of different types of projectors in use make even brief mention of the characteristics of each quite impossible here. The British "Silent Empire," and the American "Simplex" are both very fine machines, and so also are those of Messrs. Pathé Frères, Gaumont, Ruffles, and Walturdaw. In addition to these well-known types, however, there are several excellent machines made by smaller English and foreign firms, who have not always received the encouragement they deserved.

It may not be out of place to say something here of the screens on to which the projectors throw the shadow images. One of the best forms of screen for this purpose is a very fine white plaster wall. Its chief drawback is that unless great care is taken when making and mixing the ingredients there will be a tendency for the

wall to condense the atmospheric moisture, and when this takes place water will trickle down the surface and cause lines to appear on the pictures. A plaster wall is usually coated over with white oil flatting. Screens made of tightly stretched canvas are usually painted with distemper. In theatres which are very long and narrow, necessitating great brilliance to enable the audience at the back to see properly, screens coated with bright aluminium paint are frequently used.

The German "Perlantino" screen is coated with white, but has small transparent glass beads sprinkled thickly and evenly over its surface. In the United States there is a variety of patent preparations, several of which give either a ground-glass appearance or else a very glaring silver-like reflection. The former being artistic and restful and the latter very brilliant and sharp. In England, also, there are quite a number of special coatings for cinematograph screens, but it would appear that the ideal has yet to be devised.

Before leaving this subject there is a very ingenious little apparatus which calls for mention. It is the "De Vry Portable Projector," which weighs only 20 lbs., and is simple, safe, and self-contained. The De Vry is not a toy, as it takes standard gauge films, thus giving a very wide range of existing subjects, and throws on to the screen pictures up to 8 ft. wide. Its particular merit lies in the fact that it can be carried about like a suit-case, has only to be connected by a flexible lead to any ordinary electric lighting system, and so becomes available for showing motion pictures in universities, schools, factories, offices, and lecture-rooms. It has been termed the *silent salesman* because of its suitability for use by commercial travellers when explaining the actual making and distribution of the wares they are endeavouring to sell.

CHAPTER XI

FILM EXHIBITION

RELIABLE estimates place the number of cinematograph theatres in the world at about 87,000. These exhibitions require for their programmes approximately 1,500,000,000 ft. of film per week, of which at least 50,000,000 ft. should be new subject matter.

In the United States there are 16,900 cinemas and in Great Britain only just over 4,000, but in the latter country there have been but very few theatres erected since the beginning of the Great War, in 1914, and it is considered that at least 2,000 more are required in order to comfortably accommodate the rapidly growing audiences. Half the continent of Europe is in the same plight, and the demand is strong for both cinemas and films. The Far East, with its countless millions of people, is awakening to the lure of the screen. South America possesses thousands of cinemas, some of which are among the finest in the world. In the British Colonial Empire the electric theatres range from palaces to prairie-shows ; and whether it be under the light of the aurora or in the rays of the mellow tropical moon there will be found every night in the year millions of devotees at the shrine of this new goddess of romance.

With these facts in mind we can approach the final stage of this survey with some knowledge of its relative importance.

About the actual construction of an electric theatre little need be said here beyond the fact that it must almost everywhere conform to certain laws and bye-laws framed to secure the safety, comfort and health

of patrons. Foremost among these regulations, so far as Great Britain is concerned, are those aimed at the prevention of fire and panic. There must be an adequate number of clearly indicated exits, so placed as to afford the audience a ready means of egress from the building, and the passages and staircases leading to these exits must be kept free of obstruction. The latter part of this regulation is so often flagrantly disregarded that it becomes the duty of the public, for the sake of health as well as safety, to at once report to the police or local licensing authority any persistent overcrowding of a cinema which causes patrons to stand in, and thereby obstruct the gangways or in front of recognized exits.

The actual fire-extinguishing appliances considered necessary include buckets of water, dry sand, a damp blanket, and a certain number of portable chemical fire extinguishers. The sand and the damp blanket are intended for smothering the flames in the event of spools of film catching fire in the operating box. Fires produced by the short-circuiting of electric leads can best be extinguished with dry sand.

The operating box in which the projectors are housed must be completely fire-proof, and situated away from the auditorium. The door leading into the box must be self-closing and smoke-tight, any pipes used for the purposes of ventilation should lead direct to the outside of the building, and only two openings or windows for each projector installed are allowed. One of these windows is intended for projection and the other for observation ; both must have fire-proof safety shutters which can quickly be closed from either inside or outside the box. No smoking is allowed while an exhibition is taking place and none but authorized persons are allowed in this box.

There are also stringent regulations relating to the

storing of spools of film, projectors, electric cables, lime-light, acetylene, gas-engines and dynamos.

Many of the larger electric theatres also have a fire-proof re-winding room which connects with the operating box. In this apartment is situated the gear used for *re-winding* the spools of film after they have passed through the projector. Before a film can be used a second time it must be re-wound, otherwise the picture action would be reversed, the last scene being shown on the screen first. Here also is the *inspection bench*, which is merely a fire-proof table with a plate glass window capable of being lighted from beneath by an electric lamp, over this the film is passed by the re-winder, before exhibition, in order that minor defects may be observed and remedied.

A *film-mender* is also a necessary appliance for either the re-winding room or the operating box. This simple little device holds the broken ends while the join is made by cleaning the gelatine coating from the celluloid base and sticking the two clean ends together with specially prepared film-cement (see Fig. 23). The temporary joining of a film which breaks during projection is accomplished by holding the two ends together either with a special *film clip* or else with an ordinary paper fastener of the kind which does not pierce the material held. These emergency joins can be made permanent with cement after the exhibition of the broken film is over.

Owing to the possibility of one machine breaking down during an exhibition nearly all electric theatres have at least two projectors installed in the operating box. These are worked on what is called the " change over " principle. If the subject is a two-reeler then No. 1 projector opens with the first reel or spool and when this is nearing its end the arc light in No. 2 projector

is struck, the light is dimmed in No. 1, brightened in No. 2, and the second reel is thrown on the screen by No. 2. This enables a multi-reeled film to be shown without a break, unless one of the projectors breaks down, in which event a wait while the first reel is taken off the projector and the second threaded up, is absolutely unavoidable.

The reason why long films are not rolled in one is that a standard sized spool, made to fit all types of projectors, can take only from 900 to 1,200 ft. of film. A subject over this length must therefore be divided into parts, which are called "reels," but refer to the standard sized spools on to which the film itself is wound for storage, transport, and projection.

The supply of electric current for the projectors as well as for lighting and possibly heating a theatre may be derived from a town supply, or may be made on the premises by gas or oil engines coupled to dynamos. The latter method is far the most satisfactory as it supplies a plentiful, comparatively cheap, and steady supply of current which is essential for good projection, but a complete duplicate set of machinery is necessary as a precaution against breakdown, and a special fire-proof room must be built to house the engines and dynamos.

About the complicated electrical gear necessary for the supply of current to, and control of the arcs in the projectors, the theatre lighting, heating and ventilating (fans), and the motors for turning the projector mechanism, nothing will be said here because they are matters for the electrician and do not form a legitimate part of the film industry, although operators should have a good knowledge of lighting and power generally, and theatre managers would do well to acquire such a knowledge, even if they are not called upon to exercise it as a general rule.

Artificial light photograph, reproduced by permission of the British Thomson-Houston Co. Ltd.

A WELL-LIGHTED CINEMA

("EYE-REST" SYSTEM)

Far too little attention has been given in the past, so far as Great Britain is concerned, to the ordinary lighting system of picture theatres. Even to-day it is by no means uncommon to find the auditorium suddenly flooded with the dazzling rays of unshaded lights directly a picture has been shown. This sudden transition from darkness to light occurring several times in the hour is not only exceedingly trying to the eyes of patrons but is positively injurious to those of the attendants. The ideal system is one which gives a sufficiency of illumination without glare, and is switched on and off in three stages.

Almost everyone who may chance to read this little book will have noticed the unpleasant shock not only to the retina of the eye but also to the nerves when the full glare of light is suddenly turned on after a long and possibly engrossing picture. At many theatres during the early part of the evening the lights are switched on by stages ; this sensible way gives place, however, to a positive frenzy of light flashing and increased projection speed towards the close of the exhibition, causing an unpleasant and quite unnecessary amount of eye-strain.

The " Eye Rest " system of throwing the light upwards on to the ceiling, instead of downwards in full glare on the audience has much to recommend it.

Yet another annoyance due entirely to ill-conceived lighting is the presence in gang-ways of single unshaded *white* lights which, although dim, are quite sufficient to spoil the effect of a picture and at the same time be exceedingly irritating to patrons sitting in the near-by seats. Deep ruby lamps are all that is necessary and even these are better shaded from the rows of seats, so that the light they emit is confined to the gangway only.

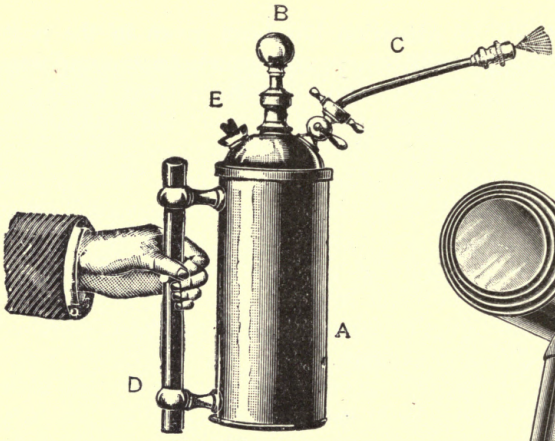


FIG. 28

SUPERIOR TYPE OF AUTOMATIC SPRAY

A = Vessel holding 6 pints of disinfectant,
B = Air pump for generating pressure
C = Swivel-arm and spray
D = Handle
E = Filler

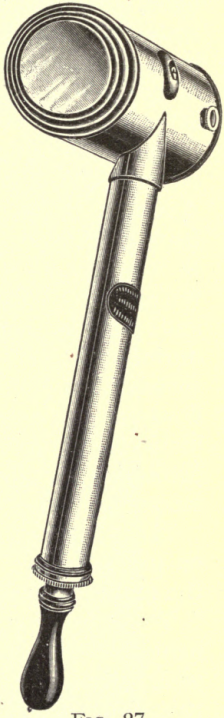


FIG. 27

"EMPIRE" PNEUMATIC DISINFECTANT SPRAY FOR THEATRES

The purification of the air in electric theatres by means of vaporizers or sprays is a decidedly good practice, but it not infrequently happens that the liquid employed is more odoriferous than germicidal. It might be beneficial to health if some competent body or authority gave out publicly what medical opinion considered the best disinfectant for such a purpose.

With regard to the sprays themselves little need be said. The "Empire" hand type consists of a pneumatic pump by the aid of which a finely divided spray of hygienic fluid can be projected into the air (Fig. 27). These sprayers hold about a quart of liquid which is sufficient for 1,000 puffs. The automatic type of the same make is, however, far superior. One pumping is sufficient to supply power to give a continuous spray for about an hour. It emits a fine dew-like spray which immediately refreshes and purifies the atmosphere (Fig. 28).

It may be interesting to note with regard to the seating capacity of theatres that at least 22 ins. to 24 ins. should be allowed between the centre of one seat and the centre of the next, and from 30 to 34 ins. spacing between the rows. Gangways should never be less than 4 ft. 6 ins. to 5 ft. in breadth. From these figures a very simple calculation will give the seating capacity of any given floor space without uncomfortable overcrowding.

Although it is no part of this work to refer to the relations between capital and labour in the film industry, something must be said here regarding the various trade associations, many of which are more protective than aggressive.

In addition to the various literary, dramatic, and advertising associations, which, by the nature of the professions they represent, have certain interests in

the film industry, there are the Cine-Camera-men's Society, an organization for those engaged in the photographic branch of the industry, similar to the New York and San Francisco Kinema Clubs and the Incorporated Association of Cinematograph Manufacturers, founded to promote the welfare of members and the industry generally. In the case of this Association the " trade " is held to mean manufacturers, publishers, and sellers of cinematograph films, as well as all allied trades, whether carried on in England or elsewhere. It is, however, more an organization of the technical and professional branches than of the whole industry.

The Incorporated Association of Film Renters has a membership limited to individuals or firms actively engaged in the renting of cinematograph films, and its objects include the protection of trade interests, the suppression of piracy and the duplication of films ; the collection of information regarding trade status, and safeguarding of the interests of members in regard to any proposed restrictive legislation.

The association with the largest membership is the Cinematograph Exhibitors Association of Great Britain and Ireland, which is an organization of retail traders, if such a term is applicable to the actual exhibitors of moving pictures. It has for its objects the maintenance of the rights, the furtherance of the interests, and the protection, in their relations with Parliament and local authorities, of the Cinematograph Exhibitors of the British Isles.

In this powerful association there are three classes of membership ; (*a*) for those who own one or more cinematograph theatres, but do not carry on the business of film manufacturers or renters ; (*b*) those who own one or more theatres and also carry on the

business of film manufacturers or renters ; and (*c*) any person interested either financially or practically in the cinematograph industry. This association has many distinct branches and is steadily increasing its already large membership.

The employees of electric theatres have organizations devoted to their interests, one of which is of a semi-technical character and is called the National Association of Cinematograph Operators, another is the National Association of Theatrical Employees, membership of which is open to all who are employed on the staff of picture theatres or are engaged in the amusement world ; and the musicians have their union, which embraces the orchestras of theatres generally.

The approximate number of persons employed in the cinematograph industry in the United Kingdom has increased from just over 1,000 in the year 1904–05 to 170,000 in 1916–17, and 209,000 in 1919–20. The number of patrons visiting the 4,000 odd electric theatres each week has been estimated at from 7,000,000 to 9,000,000, and the capital invested in these buildings at considerably over £90,000,000 sterling.

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